EXHIBIT A

6-12-94 → 6-18-94

[redacted]	MARRIOTT INTERSTATE N HTL ATLANTA GA	00108262	

5/28	6/08	33609403	GOLDEN CORRAL	ATHENS	TX
6/09	6/08	IOZ8LI8S	[redacted]	BINGHAM FARMS	MI
[redacted]	6/12	N3CZ2BPQ	[redacted]	STONE MOUNTAI	GA
6/07			515 INWOOD	DALLAS,	TX
				DALLAS	TX

		Reference Number	Charges and Other Debits	Payments and Credits
[redacted]	MARRIOTT INTERSTATE N HTL ATLANTA GA	00108263		
[redacted]	BUDGET RENT A CAR EAST POINT GA	0460099Z		

ITEM 013
NORTONS/BUCKHEAD ATLANTA GA

05/12/94

00008482F

27

NORTONS/BUCKHEAD ATLANTA GA

FOOD AND BEVERAGE
TIP

6/12

S/E #

TOTAL CHARGE AMOUNT

Exhibit "A"

WCC2705

ents
Credits

CONTINUED FROM PREVIOUS PAGE J.W

06-11-94	AMERICAN AIRLINES DAL/FT WRTH TX DALLAS/FT. WORTH TO ATLANTA TICKET #0012179123187	16200104
06-11-94	AMERICAN AIRLINES ATLANTA GA ATLANTA TO DALLAS/FT. WORTH TICKET ~~#0012179123189~~	16200104
06-11-94	AMERICAN AIRLINES ATLANTA GA ATLANTA TO DALLAS/FT. WORTH TICKET #0012179123191	16200104
~~06-14-94~~	~~MARRIOTT INTERSTATE N HTL~~ ATLANTA GA	~~00108262-~~
06-14-94	~~MARRIOTT INTERSTATE N HTL~~ ATLANTA GA	00108265

3.0 hrs

JW

JW

0.1 hr

TOTAL FOR CARD: 3855 530862 0037

Previous Balance	- Payments	- Credits	= Past Due Balance
[redacted] Late Fees	+ New Charges	+ Other Debits	= Diners Club Balance Due

Atlanta Trip

[redacted]

Bill D.

JW

W002706

CUSTOMER COPY

ESTABLISHMENT NAME

MORTON'S
ATLANTA, GA
4101007815000000 01

DATE	APPROVAL CODE
JUN 12, 94	27

CUSTOMER NAME
JS WILLIAMSON
371381322136008
AMEX 96/11

TRANSACTION TYPE
SALE COMP. 0002

RECORD OF CHARGE #	TERMINAL #
094924	50012694

DESCRIPTION OF PURCHASES/SERVICES
FOOD AND BEVERAGE

BASE AMOUNT	$154.07
TIP AMOUNT	25.00
TOTAL	174.07

CUSTOMER SIGN HERE
X

Cardholder acknowledges receipt of goods and/or services in the amount of the total shown hereon and agrees to perform the obligations set forth in the Cardholder's agreement with the Issuer.

W013259

EXHIBIT B

June 1994

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday/Sunday
30	31	1	2	3	4 / 5
6	7	8	9	10	11 / 12
13	14	15	16	17	18 / 19
20	21	22	23	24	25 / 26
27	28	29	30		

Month 6

6 months left

Exhibit "B"

W013261

July 1994

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday/Sunday
	28		30		2 3
4	5	6	7	8	9 10
11	12	13	14	15	16 17
18	19	20	21	22	23 24
25	26	27	28	29	30 31

Month 7 5 months left

W013262

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Reissue Application of: BILL L. DAVIS and JESSE S. WILLIAMSON	§	
For Reissue of U. S. Patent 5,630,363 Issued May 20, 1997 Serial No. 08/515,097	§	Group Art Unit: 2854
Filing Date: May 20, 1999 (Reissue)	§	Examiner: __________
Serial No.: 09/315,796 (Reissue)	§	
For: COMBINED LITHOGRAPHIC/ FLEXOGRAPHIC PRINTING APPARATUS AND PROCESS	§	

RECEIVED
FEB 23 2001
TECHNOLOGY CENTER 2800

09315796 .052201

DECLARATION OF JOHN W. BIRD

TO: The Honorable Commissioner of Patents and Trademarks
Washington, D.C. 20231

SIR:

I, John W. Bird, declare on my oath the following:

1. I am over twenty-one (21) years of age, have never been convicted of a felony, and am competent to make this testimony. I am President of JB Machinery Incorporated, 9 Sasqua Trail, Weston, CT 06883. My *curriculum vitae* is attached hereto as Exhibit 1.

2. I have read U.S. Patent 5,630,363 to Davis and Williamson and am familiar with its specification, drawings, and claims. A copy of the '363 patent is attached hereto as Exhibit 2. I am aware that Davis and Williamson filed a reissue application seeking to make corrections in some of the claims of, and also seeking to add new claims to, the '363 patent, specifically claims 42-87. A copy of what I understand to be the reissue claims, which I have read, is attached as Exhibit 3.

3. For the reasons that follow, and in view of my personal knowledge of the events which occurred at Printing Research, Inc. ("PRI") and Williamson Printing Corporation ("WPC") between 1991 and 1995, I believe that Bill Davis and Jesse Williamson are the first, true and correct inventors of the claimed invention of the '363 patent, as well as the subject matter of their reissue claims. Furthermore, based on my more than 35 years of experience in the printing industry, I believe that the printing methods and presses claimed in the '363 patent, as well as in the reissue claims, were a significant advance in the mid-1990s.

4. I am aware that, on or about May 20, 1999, Plaintiffs Howard D. DeMoore and PRI filed a lawsuit in the Northern District of Texas styled *Printing Research, Inc. v. Williamson Printing Corporation, Bill L. Davis and Jesse S. Williamson*, Civil Action No. 3:99CV1154-D (Exhibit 4). In paragraph 10 of Plaintiff's Original Complaint, it is alleged that Howard W. DeMoore is the sole inventor of the claimed invention of the '363 patent, and that DeMoore himself conceived and developed a single-pass printing process "for selectively applying printing inks and coatings to paper and other substrates, in which one of the stations utilizes a flexographic process and at least one of the successive stations utilizes a lithographic process." These allegations are each false. Based upon my personal experience obtained while working at PRI, these allegations as well as similar allegations in the Complaint are false; Howard W. DeMoore did not conceive or reduce to practice the process invention broadly characterized as combining a flexographic step with downstream offset lithography. That simply did not happen in 1994 or 1995 or before.

5. To the best of my knowledge, there are no 1991-1995 conception memoranda, invention memoranda, notes, e-mails or memoranda of a conception of the use of a flexographic station prior to offset lithography authored by DeMoore, me or Rendleman or anyone else at PRI.

6. I was employed by PRI from early 1991 until early January 1997 when I was terminated as an employee. I was exclusively retained as a manufacture's representative for flexographic and converting products in June 1997. I was terminated still again as a sales agent in March 1998, and recently I settled a lawsuit with PRI who sued me and my new company (JB

Machinery) for alleged trade dress infringement and copyright infringement over my company's new brochures concerning drying equipment. Prior to early 1991, I was a principal (President and CEO) in Birow, Incorporated, located at 8 Clover Lane, Westport, Connecticut 07880. Shortly after arriving at PRI in early 1991, as part of the negotiations with PRI, I was required to grant PRI an exclusive license in Birow's proprietary methods and apparatus developed by me. See Exhibit 5. That license included U.S. Patent Nos. 4,796, 556 (Exhibit 6), 4,841,903 (Exhibit 7), 4,895,070 (Exhibit 8), and 4,939,992 (Exhibit 9), as well as a patent application, Serial Number 07/336,435, filed the same day as the application leading to the '992 patent, which I believe never issued. My experience that I brought to PRI was in the graphic arts (litho, flexography screen printing and coating applications) and associated industries, including the construction of coaters and driers. As of 1991, I do not recall flexographic applications existing in the offset lithography art other than end-of-press specialized applications. The arts were different. Flexography was used in the manufacture of boxes, bags and labels. I also brought with me to PRI a retractable, end-of-press coater, or "rack-back" coater as the term is often used in the industry. As I recall, we sold very few of these at PRI. A copy of a PRI brochure (printed about 1994) depicting this technology, which I brought to PRI, is attached hereto as Exhibit 10. At the time I arrived at PRI in early 1991, PRI was developing and trying to sell the so-called "E-Z" coater which I understand was developed in the early 1990s, and which used a chambered doctor system, the subject of several PRI patents (U.S. Patent Nos. 5,176,077, 5,207,159, and 5,335,596, attached hereto in a group as Exhibit 11). I believe I was the only person at PRI in 1991-1995 that had any significant experience in flexography. In hindsight, the only people anywhere in the world which would have had the motivation in 1994-1995 to go "upstream" with flexography in an offset lithography press would be a printer or a manufacturer of inks or coating, probably metallic inks or coatings. A small manufacturer of auxiliary equipment for presses, such as PRI, in my opinion would not have such motivation other than to produce a product in response to an order.

7. When I joined PRI in early 1991, the principal efforts of PRI were involved in the field of anti-marking technology. The company was heavily financially dependent on selling specially-tailored sheets of cheesecloth as an anti-marking tool (U.S. Patent No. 4,402,267, Exhibit 26 hereto), the so-called "Superblue™" netting, to expire in September 6, 2000. I feel my contribution to PRI was primarily in the development of drying equipment, including end-of-press and interstation drying equipment and to introduce them to a retractable or "rack-back" coater.

8. In February 1991, at about the time I arrived at PRI, Howard DeMoore filed a lawsuit against WPC, styled *Printing Research, Inc. and Howard W. DeMoore v. Williamson Printing Corporation, Jerry B. Williamson, Jesse Williamson and Buford Roy Williams*, Civil Action No. 3:91-CV-0389-X (Northern District of Texas, Dallas Division), which was settled on or about October 1, 1993. The basic terms of the settlement had been worked out several months before October 1, 1993 (actually sometime in May 1993, as I recall), and accordingly, I started approaching Williamson in the early summer of 1993 to start purchasing PRI's products (see letter of June 25, 1993, authored by me, Exhibit 12). On several occasions in late 1993 and the first half of 1994, I dropped by the offices of WPC, providing brochures and handouts of PRI products I thought WPC might possibly be interested in.

9. I was aware in 1993 and 1994 that WPC was seeking to replace its aging printing presses with new, state-of-the art presses, and I was aware by July of 1994 WPC had more or less decided to go with Heidelberg U.S.A., Inc. and purchased several different presses, to be installed starting in late 1994 and running well into 1995. This presented PRI, in my opinion, with a significant opportunity, as PRI sold good auxiliary drying equipment. I was a major contributor at PRI into the invention, research and developing of drying equipment.

10. I became aware from Steven Baker, one of PRI's salesmen, upon his return in July 1994 from Atlanta, Georgia, of a meeting between Steven Baker, Jesse Williamson and Bill Davis of WPC. Steven Baker told me of a July 1994 meeting in an Atlanta restaurant in which Davis and Williamson told him (Baker), in confidence, of Davis and Williamson's intent to

improve the so-called "WIMS" metallic printing process of WPC, U.S. Patent No. 5,370,976 (Exhibit 13), of which at the time I had some familiarity with the process, but not a lot. Baker told me in July 1994 that WPC had already committed orally to purchasing dryer equipment from PRI for the line of Heidelberg printing presses, and that Baker had shown Jesse Williamson and Bill Davis a PRI-Constructed HV interstation dryer at a local carton printer manufacturer in the Atlanta area, James River, and that Baker had been told of a pending WPC patent application for the "WIMS" process. Baker told me that as part of these discussions, they confided in Baker that they wanted to use flexography at a station they designated "up-stream" – perhaps even the first station – of one or more offset lithography presses that they would receive from Heidelberg. Baker mentioned to me at the time in July 1994 that they mentioned several ways in which this could be done -- most preferably, a retractable or "rack-back" mechanism, which would have to be modified for "upstream" use. Baker told me that with respect to the "rack-back" option told him by Davis and Williamson, they would have to have the retractable mechanism have an anilox roller, a chambered doctor, and the use of state-of-the-art flexographic plates. Baker told me that Davis and Williamson indicated they had just seen the use of some of these flexographic (BASF) plates in Germany, and that a number of companies sold high-resolution plates which would work in their new process. Baker told me that Davis and Williamson inquired whether PRI was interested in supplying these types of "rack-back" or retractable mechanisms, and that he (Baker) told Williamson and Davis of the PRI "rack-back" and provided a brochure, Exhibit 10. Effertz Tool Company, Franklin Lakes, New Jersey, made these "rack-backs" for me while at Birow, Incorporated, and Effertz continued to make these "rack-backs" for PRI for the few units PRI sold when I brought the technology to Dallas.

11. Pursuant to what I understood to be an oral agreement in July to purchase equipment from PRI, I passed along product information in detailed form to WPC regarding the drying equipment WPC had promised to purchase from PRI on August 31, 1994 (Exhibit 14). WPC had signed an agreement on October 1, 1993 with PRI to purchase a significant amount of drying equipment, including interstation drying equipment (note my memorandum of

September 6, 1994 (Exhibit 15), and Howard DeMoore's acknowledgment on the very same day that the terms of the Settlement Agreement had been complied with contingent on completion of the purchase (Exhibit 16)). I supplied WPC with a final purchase agreement schedule on September 15, 1994 (Exhibit 17).

12. Steve Baker also told me on his return to Dallas in July 1994 that Davis and Williamson wanted some experiments run at PRI using my "rack-back" (note again brochure, Exhibit 10). I recall such experiments at PRI conducted in the fall of 1994. These tests were done on PRI's two-color Heidelberg R&D press utilizing an existing "rack back" coater of my design at the end of the press, at the direction of WPC, with WPC supplying most of the flexographic inks and the flexographic plates for the experiments. The tests were chiefly designed to determine the resolution that was possible with the PRI coater, and supplied plates and coatings. No one-pass tests of the claimed '363 process were done in the fall at PRI. In fact, to the best of my knowledge, no tests were ever conducted at PRI of the '363 invention, only at WPC. In fact, to the best of my knowledge, no off-line simulated tests (flexography done first with a second pass of performing offset lithography in a pass-through) were ever performed at PRI. I never collaborated with Bill Davis or Jesse Williamson or anyone else at Williamson concerning the '363 invention in 1994 or 1995. Again, PRI, to the best of my knowledge, does not have any late 1994 or early 1995 record, notebooks, e-mails or memoranda concerning any conception by PRI of the '363 claimed invention.

13. I suggested that my colleagues start working toward an acceptable flexographic printer coater for use with the Davis-Williamson '363 process. In the late fall of 1994, pursuant to my recommendations, PRI did start working on what was termed in-house as the "Rendleman coater," the first prototype being a cantilevered, "short-arm" device that would fit on an end-of-press Heidelberg-manufactured coating tower of the first Heidelberg press to arrive at Williamson – the so-called "7 color Heidelberg CD." The purpose of our development of the device was clear: we did this to try to get all of WPC's business. We had no firm orders from them for this equipment. That prototype was actually not installed at WPC until late February

1995. The following documents illustrate the timing of development of this short-armed device, which was not intended for interstation deployment, but for use on the low profile of the tower coater with the intention of going upstream at a later date. On December 16, 1994, I wrote a memorandum to Bill Davis of Williamson (Exhibit 18), in which construction of the proposed short-arm device was not even mentioned. As of that time, only parts of it had been developed by Ron Rendleman, and sat on the floor at PRI. I did not mention the "short arm" device in the December letter. Steve Baker did not even mention the short-arm prototype in his late January 1995 letter to Jesse Williamson (Exhibit 19). Had PRI had the prototype near ready for installation, it would have been mentioned in a letter. In my opinion, the time to develop short-arm prototype of the "Rendleman coater," which was a crude, manually operated device, which took more than 90 days, taken even at a causal pace. Working back from a late February installation, it is clear work on the "short-arm" experimental coater started no earlier than December 1994, which is consistent with my recollection. The "short-arm" device was never intended to perform as an interstation flexographic coater, and could not have. The reason why PRI started working on an experimental, cantilevered end-of-press printer-coater, rather than an interstation unit to perform the '363 process, was that in December 1994 PRI had no commitment from WPC to order such devices, there was no established market for an interstation, and no one at PRI appreciated, much less knew of the details of the '363 inventive process outside of the disclosure made to Baker.

14. I recall that in January 1995 a meeting took place in Conference Room "E" at WPC attended by Steve Baker, me, Bill Davis and Jesse Williamson. At this meeting, Jesse Williamson told Steve Baker and me that he (Williamson) and Davis were going to file for a patent on their new process. I recall commenting to Steve Baker going back in the car to the offices at PRI that I thought it was amazing that anyone could patent a process apart from the equipment – the so-called "iron," which is a term used by many people in our business. I thought it was a brilliant move, but did not know whether such patenting could take place. I had several

patents issue to me as of January 1995 (Exhibits 6-9), but didn't know that such a process could be patented, however meritorious.

15. I recall another meeting which took place on February 11, 1995. Jesse Williamson and Bill Davis told me that they had gone to Germany to the Heidelberg Company. They informed me in confidence that they had had tests conducted on a simulated reduction-to-practice of the new process to be patented, using state-of-the-art BASF plates at the Heidelberg Company with German and British flexographic inks. They indicated they had compared in Germany the results of a gold and silver Rolex advertisement they had previously made using the "ordinary" WIMS process, with a simulation of the new process, using multiple passes comprising flexography performed first, followed by offset lithography. They indicated to me on February 11, 1995 that the German tests confirmed the advantages and benefits of their new process. Accordingly, they committed not only to installing the existing short-arm prototype still in production at PRI, but for PRI to install a long-arm device for interstation use at WPC if PRI could come up with a workable design. Accordingly, I sent them a confirmatory memorandum on February 16, 1995 (Exhibit 20), indicating that the "short-arm" end-of-press unit was to be provided for no cost. We actually installed the "short-arm" unit at the end of February, 1995. We did not even have a sketch of the interstation coater to provide Williamson until March of 1995 – let alone completed blueprints -- and our development of the interstation coater was just a concept in late April 1995 when we had brochures printed in gold and silver – not even with the improved process (Exhibit 21). We provided an incomplete sketch of the prototype interstation "Rendleman coater" to Bill Davis in March 1995, which was apparently completed by Davis and Williamson, modified and put in the '363 process as Fig. 2. The first of the interstation units was not installed until late August, or early September 1995, as I recall.

16. In late March of 1995 I observed as part of a team of employees at PRI a simulated reduction of the '363 process using the "short-arm" device – i.e., "offline" (as Bill Davis and Jesse Williamson called it) – for a customer in Washington, D.C. (Brian Liester, Hi Fi Color, Mills Davis)). The simulated reduction was conducted at WPC, using state-of-the-art

plates and flexographic inks, under the direction of Bill Davis. The work done for Liester later won an industry prize in the fall of 1995 (PIA's Premier Print Awards), at Chicago, Illinois. To the best of my knowledge, no one at PRI ever claimed that PRI should share in the recognition of that prize.

17. In March 1995, I test marketed a closed doctor blade chamber recirculation system at a graphics show held biannually in Charlotte, NC. John Lapomarde (retired) previously with Rexham Corporation, had purchased such a unit. PRI sold a system to Lapomarde for installation at the end of his Komori multi-color press, replacing an application roller with an anilox roller, and installing PRI's recirculation closed doctor blade system, on or about mid-to-late 1994. Prior to the installation, we ran tests at PRI to apply metallics and coating using the retractable coater at the end of Pri's two-color Heidelberg press. Howard DeMoore and Ron Rendleman had no input into the tests or our process. Sometime in the spring of 1995 Steve Garner and I showed Jesse Williamson the flexo-applied gold sheets shortly thereafter. That was my first inkling of the potential and subsequent idea to install such device upstream on a litho press. I do not recall writing any memorandum, notebooks, e-mails, or other writings at PRI describing this concept. I never told anyone at WPC about this process.

18. On May 2, 1995, Steve Garner of PRI and I had a meeting at the offices of WPC with Jerry Williamson, Jesse Williamson, Bill Davis and Woody Dixon. The issue of who had what exclusive rights to what part of these marvelous inventions – the process and the "Rendleman coater" -- came up for the first time, as I recall. No one from PRI questioned WPC's and Davis' and Williamson's rights to patent the process, if they could – after all, they had told us about the process back in July 1994. This meeting was the first in a series of meetings to discuss potential exclusivity in WPC to sell the interstation "Rendleman coater" – which had not even been developed yet, let alone reduced to practice. Our original proposal was that PRI would agree to give WPC some degree of exclusivity on selling the "Rendleman coater" to others. In this same time frame, Ron Rendleman, Howard DeMoore and I signed a U.S. patent application to the "Rendleman coater" on May 4, 1995 or a day before, without telling WPC

about it. WPC never claimed in our meetings, or in any letter to PRI to the best of my knowledge that any of their people invented the "Rendleman coater." They just wanted us to come up with an interstation coater to perform their process, which we did. They could have gone to any one of a number of manufacturers of end-of-press auxiliary coaters and had these devices modified in a relatively short amount of time for interstation deployment. It is my belief that WPC chose PRI because of the October 1, 1993 settlement agreement. Our May 4, 1995 application, as I understood it then and understand it now – did not claim the '363 process. We could not have claimed the process. First, we were not the inventors of the process, and second, we had insufficient information about conducting the process or the results to be expected to make a good disclosure. As of May 4, 1995, PRI knew that WPC intended to file a process application, if it had not already done so. On May 12, 1995 I wrote a confirmatory letter concerning the first interstation unit for WPC (Exhibit 22), which we promised would arrive in mid-August. In fact, it was several weeks late. The short period of 90 days for completion indicated in my May 12, 1995 letter was a reasonable time for the development and installation WPC could have obtained from any other existing competent manufacturer of an auxiliary unit modified for interstation deployment.

19. After my May 12, 1995 letter, PRI and WPC went back and forth in negotiations concerning the extent to which WPC could sell exclusively the "Rendleman coater." To the best of my knowledge, the parties were close but never reached an agreement in writing. It was a failed cross-licensing negotiation, as the correspondence clearly shows.

20. Four cantilevered "Rendleman coaters" were delivered to WPC. To the best of my knowledge, PRI delivered two interstation "Rendleman coater" units to WPC in 1995-1996, the first of which was delivered in late August 1995. End-of-press units were delivered in late February 1995 (the experimental prototype) and early 1996.

21. To the best of my knowledge, WPC never gave PRI a license to make, use, or sell the "Rendleman coater" for performing interstation '363 process. I am not aware of any effort

on the part of PRI to approach WPC at any time for such a '363 process license for PRI or the Hallmark Company or anyone else.

22. On October 2, 1995 Rendleman, DeMoore and I filed a second, now series of four patent applications directed to interstation use of flexography where the flexographic stations were not auxiliary units, but dedicated – the press units would have to be substantially modified. To the best of my knowledge, this invention was never actually reduced to practice by PRI, let alone sold. Of the four applications filed in the United States, three were carried forward overseas in Europe and Japan, and three have issued in the United States – U.S. Patent Nos. 5,598,777 (Exhibit 23), 5,651,316 (Exhibit 24 and very recently, 5,960,713 (Exhibit 25). These patents have as originally filed the same specification. They have nothing to do with the "Rendleman coater" and did not claim the '363 process.

23. The European counterpart of the May 4, 1995 "Rendleman coater" application was published about 18 months after May 4, 1995, i.e., November 6, 1996. (Note EP 741 025 A3, item (43), Exhibit 27).

24. Accordingly, when I review PRI's complaint, I find no important factual merit to it whatsoever. The invention of the '363 patent has never been installed or used outside of WPC. The "Rendleman coater" was developed at the suggestion of Bill Davis and Jesse Williamson for WPC. Neither Ron Rendleman or I ever developed the '363 process, let alone Howard DeMoore. Had PRI invented the process, PRI would never have taken prototypes outside the offices of PRI or told a customer about it without detailed secrecy agreements. Moreover, in my opinion, PRI had no motivation to come up with the process invention because it did not utilize the WIMS process out of which I believe the '363 patent originated. To the best of knowledge, no one at PRI ever told the '363 invention to Davis and Williamson – the reverse I know occurred in July 1994. PRI did not even have the facilities to reduce the '363 invention to practice – even by simulation. If PRI had the capability to use or to simulate the '363 process, the 1995 brochure would have been printed by the new '363 process. The brochure was not. I know intimately the details of the development of the "Rendleman coater" in 1994-1995, had

numerous discussions on a week-to-week basis with Rendleman, kept DeMoore informed as to the progress of its development and the installations of the "short arm" (late February 1995) and long-arm devices, and attended the few experiments in the fall of 1994 and the few meetings in 1995 where employees of the two companies met. No experimental or developmental work – no collaboration – occurred between PRI and WPC. Howard DeMoore was never involved in the conception or development of the interstation "Rendleman coater" – he was virtually never in PRI's offices. To the best of my knowledge, the '363 invention is the genius of Jesse Williamson, who is a visionary, and Bill Davis whose printing process experience made it possible to bring it about.

25. Contrary to the allegations in the Complaint, Exhibit 4, Howard DeMoore did not conceive, invent, reduce to practice, or develop the '363 invention, or any individual or team at PRI. I was the one responsible at PRI for trying to get the Hallmark business, and no one at WPC ever told anyone at Hallmark, to the best of my knowledge, not to do business with us. As far as I know, neither I nor Hallmark approached WPC for a license to the '363 technology. The '363 patent issued in May 1997 and of course, such a license would have been appropriate had Hallmark wanted to practice the '363 process.

26. As indicated by the testimony and Exhibits above, DeMoore and PRI have misrepresented the true facts, or are simply mistaken, in paragraphs 10-17 of the Complaint. The errors are too numerous to list here. I will give some examples. First, the tests conducted at PRI in October 1994 were at the suggestion of Williamson and Davis, and did not illustrate "potential applications of that technology." Second, DeMoore did not conceive and begin development of the "Lithoflex" system, which is described in the Complaint to include the '363 process. I was not "contacted by Williamson employees" to learn the "Lithoflex" process in November 1994 (paragraph 13). Third, I did not describe the "Lithoflex system" to anyone at Williamson (paragraph 13) let alone "details" (paragraph 14). Fourth, to the best of my knowledge, no

written confidentiality agreement was in place (paragraph 15). Fifth, Williamson never agreed to let us test generally the "Rendleman coater" at the offices of WPC (paragraph 16), let alone to give PRI a broad-based license to practice the '363 invention. Sixth, the first or "short-arm" experimental "Rendleman coating unit" was delivered in late February 1994, and was end-of-press. Seventh, the first "long-arm" or interstation unit was delivered in late August or early September 1995. Thus, the date given in paragraph 17 of the Complaint of November 1995 is wrong. Again, these are just examples of the misinformation in the Complaint.

The undersigned Declarant stated further that all statements made herein of Declarant's own knowledge are true, and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

John W. Bird

12.9.'99

Date:

1

Prior to 1982 all employment experience was in the UK

1977 - 1982	**Colordy Ltd. (Spectral Ltd., and now owned by Nordson)** **Partner & Technical Sales Director** • Founding partner for UV and IR drying systems • Directed development and sales marketing efforts for drying systems from $75K in 1977 to $1.5M in 1981.
1974 - 1977	**Print Dimensions Ltd.** **Technical and Sales Director** • Developed and marketed proprietary three-dimensional vacuum-formed plastic products
1970 - 1974	**McCorquodale Plastics/Associated Trapinex Ltd.** **Works Manager** • Managed production of litho, screen-printing and plastic laminating in the manufacture of credit cards and plastic point of purchase display products
1965 - 1970	**Sericol Group Ltd.** **Development Chemist** • Developed various ink systems for the screen-printing industry • Developed coating methods and photographic film for the screen printing industry
1960 - 1965	**Ault & Wiborg Ltd.** **Development Chemist** • Manufactured ink for litho. and developed some of the first web offset heatset inks in the UK
EDUCATION:	**1960 - 1965 London College of Printing** **1956 - 1960 St. Gerard's RC Secondary School**

ACHIEVEMENTS (US):

Nine patents issued, two GATF (Graphic Arts Technical Foundation) Intertech Awards, Special Mention AICC Technical Merit Award for HV Drying. Articles published in "Boxboard Containers", "Graphic Arts Monthly", "TAPPI Journal" and "GATF Technical Manual", Introduction and development coating litho, and flexo technical presentations made to AICC, GATF, TAPPI, University of Wisconsin and various Litho Clubs

ACHIEVEMENTS (UK):

City and Guilds Printing Ink Technicians Certificate, Member Institute of Printing (M.I.O.P.), Chairman Screen Printers Association, Six Patents Issued, Articles published in "Professional Printer", "Folding Carton", "British Printing and Screen Printing" trade magazines, Introduction and Development of short-wave infrared and "Cold" UV Drying Systems

CONFIDENTIAL
SUBJECT TO
PROTECTIVE ORDER

PERSONAL:

Date of birth August 10, 1945. Married with three children (ages 33, 20, and 28).

W000944

INDUSTRY REFERENCES AVAILABLE UPON REQUEST.

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Davis et al.

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[45] Date of Patent: May 20, 1997

[54] COMBINED LITHOGRAPHIC/FLEXOGRAPHIC PRINTING APPARATUS AND PROCESS

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[73] Assignee: Williamson Printing Corporation, Dallas, Tex.

[21] Appl. No.: 515,097

[22] Filed: Aug. 14, 1995

[51] Int. Cl.[6] B41M 1/18; B41M 7/00; B41M 1/04; B41F 23/00

[52] U.S. Cl. 101/141; 101/181; 101/183; 101/424.1; 101/424.2; 101/479; 101/483; 101/491; 101/DIG. 49

[58] Field of Search .... 101/135–138, 101/141–143, 450.1, 174, 180, 181, 183, 416.1, 424.1, 424.2, 479, 491, DIG. 29, DIG. 49, 483

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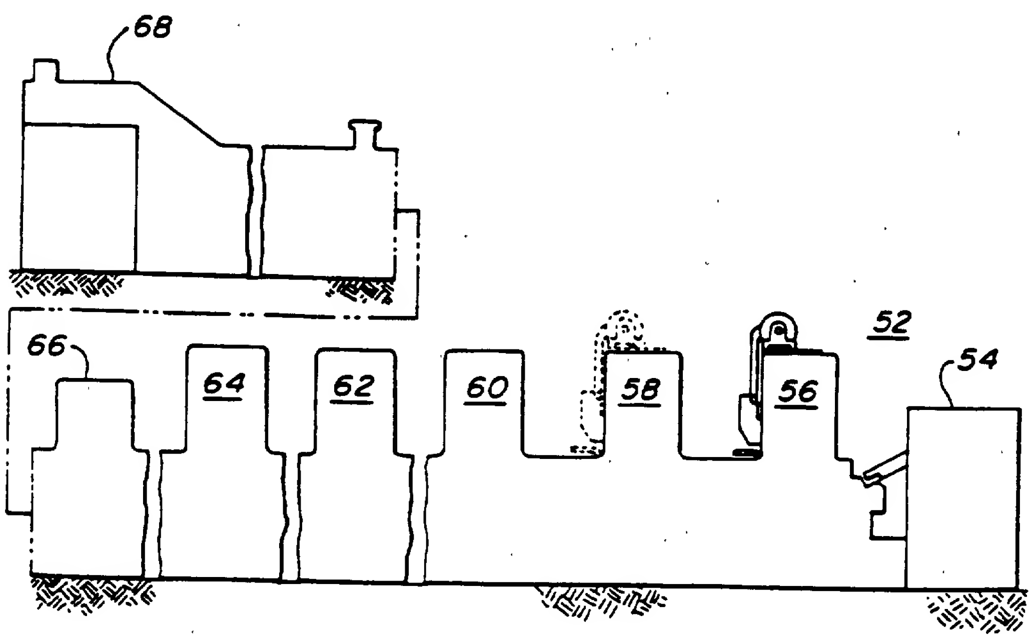
[57] ABSTRACT

A combined lithographic/flexographic printing process having a plurality of successive printing stations for printing color images on a substrate in a continuous in-line process. One of the stations prints a first color image using the flexographic process and at least one of the successive printing stations prints a second color image over the first color image using an offset lithographic process in the continuous in-line process.

41 Claims, 1 Drawing Sheet



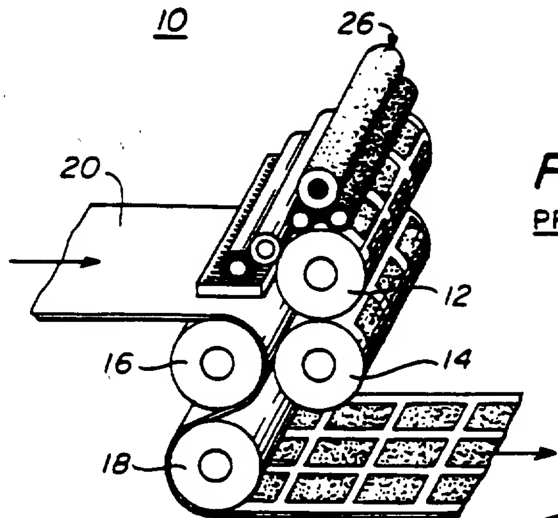


FIG. 1
PRIOR ART

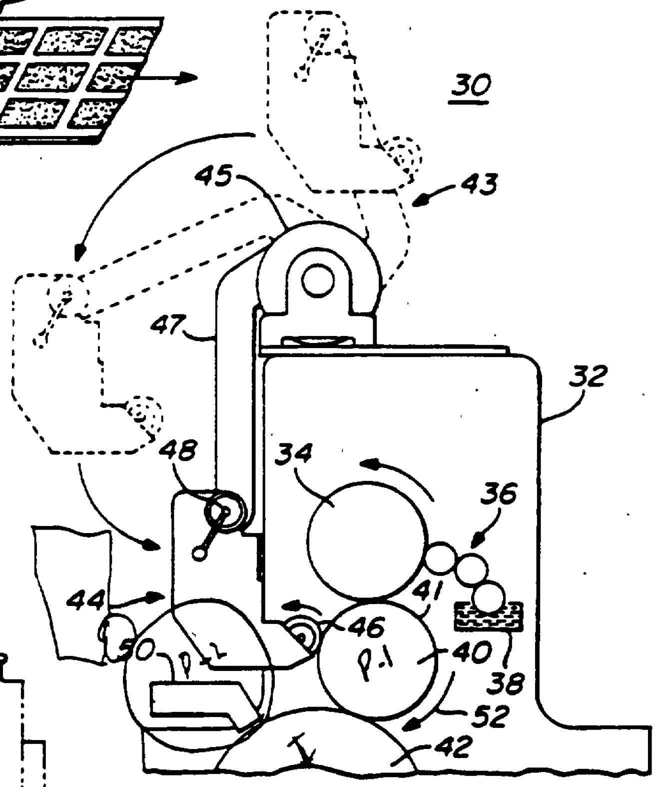


FIG. 2

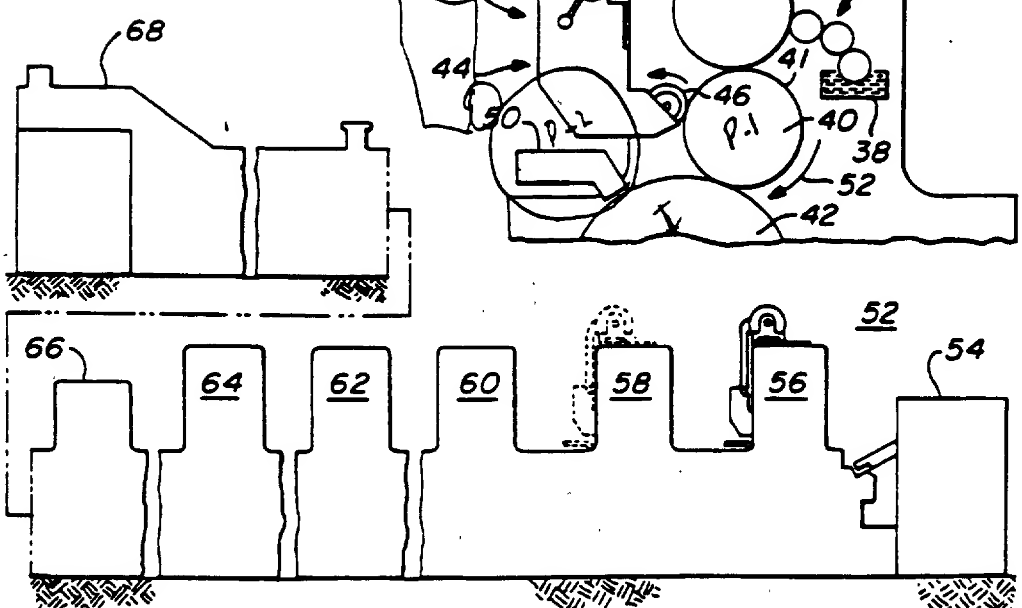


FIG. 3

COMBINED LITHOGRAPHIC/FLEXOGRAPHIC PRINTING APPARATUS AND PROCESS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates in general to printing machines and processes and in particular to a combined lithographic/flexographic in-line printing apparatus and process.

2. Description of Related Art

As used herein, the following terms have the meanings indicated:

ANILOX ROLLER

A steel or ceramic ink metering roller. Its surface is engraved with tiny, uniform cells that carry and deposit a thin, controlled layer of ink film or coating material onto the plate. In flexo presswork, anilox rollers transfer a controlled ink film from the rubber plate (or rubber-covered roller) to the web to print the image. Anilox rollers are also used in remoistenable glue units and to create "scratch-and-sniff" perfume ads.

ANILOX SYSTEM

The inking method commonly employed on flexographic presses. An elastomer-covered fountain roller supplies a controlled ink film from the ink pan to the engraved metering roller. After ink floods the metering roller, the fountain roller is squeezed or wiped usually with a doctor blade to remove the excess ink. The ink that remains on the metering roller is then transferred to the rubber printing plate.

COATER

A device with a pan to contain the coating material, a pan roller partially immersed in the coating material contained in the pan, and a coater roller to meter off a uniform film of the coating material and apply it to the printing plate.

COATING

An unbroken, clear film applied to a substrate in layers to protect and seal it, or to make it glossy.

FLEXOGRAPHIC INK

A quick-drying, fluid ink that is highly volatile or an ink that can be water based and nonvolatile.

FLEXOGRAPHY

A method of rotary letterpress printing characterized by the use of flexible, rubber, or plastic plates with raised image areas and fluid, rapid-drying inks.

HALFTONES

Dot-pattern images that have the appearance of continuous-tone images because of the limited resolving power of the human eye. This limitation accounts for an optical illusion; small halftone dots, when viewed at the normal reading distance, cannot be resolved as individual dots but blend into a continuous tone.

LITHOGRAPHIC PLATES

A lithographic plate is precoated with a light-sensitive or otherwise imageable coating, and the separation between the image and nonimage areas is maintained chemically. The image areas must be ink receptive and refuse water and the nonimage areas must be water receptive and refuse ink. The wider the difference maintained between the ink receptivity of the image areas and the water receptivity of the nonimage areas, the better the plate will be, the easier it will run on the press, and, consequently, the better the printing. There are several types of lithographic plates. The plate is an image carrier that is said to be planographic, or flat and smooth.

LITHOGRAPHY

A printing process in which the image carrier or plate is chemically treated so that the image areas are receptive to ink.

OFFSET PRINTING

An indirect printing method in which the inked image on a press plate is first transferred to a rubber blanket, that in turn "offsets" the inked impression to a press sheet. In offset lithography, the printing plate has been photochemically treated to produce image areas receptive to ink.

SLURRY

A water suspension of fibers or the suspension of pigment and adhesive used to coat papers. It may also include a suspended metallic material such as uniform-sized metal particles or nonuniform-sized metal particles.

ULTRAVIOLET INKS

Printing inks containing an activator that causes the polymerization of binders and solvents after exposure to a source of ultraviolet radiation.

Offset lithography is a process that is well known in the art and utilizes the planographic method. This means that the image and nonprinting areas are essentially on the same plane of a thin metal plate and the distinction between them is maintained chemically. There are two basic differences between offset lithography and other processes. First, it is based on the principle that grease and water do not mix. Second, the ink is offset from the first plate to a rubber blanket and then from the blanket to a substrate on which printing is to occur such as paper.

When the printing plate is made, the printing image is made grease receptive and water repellant and the nonprinting areas are made water receptive and ink repellant. The plate is mounted on the plate cylinder of the press which, as it rotates, comes in contact successively with rollers wet by a water or dampening solution and rollers wet by ink. The dampening solution wets the nonprinting areas of the plate and prevents the ink from wetting these areas. The ink wets the image areas which are transferred to the intermediate blanket cylinder. The inked image is transferred to the substrate as it passes between the blanket cylinder and the impression cylinder. Transferring the image from the plate to a rubber blanket before transfer to the substrate is called the offset principle.

One major advantage of the offset principle is that the soft rubber surface of the blanket creates a clearer impression on a wide variety of paper surfaces and other substrate materials with both rough and smooth textures with a minimum of press preparation.

Offset lithography has equipment for short, medium and long runs. Both sheetfed and web presses are used. Sheetfed lithography is used for printing advertising, books, catalogs, greeting cards, posters, labels, packaging, folding boxes, decalcomanias, coupons, trading stamps, and art reproductions. Many sheetfed presses can perfect (print both sides of the paper) in one pass through the press. Web offset is used for printing business forms, newspapers, preprinted newspaper inserts, advertising literature, catalogs, long-run books, encyclopedias, and magazines.

In offset lithography, the rubber blanket surface conforms to irregular printing surfaces, resulting in the need for less pressure and preparation. It has improved print quality of text and halftones on rough surfaced papers. Further, the substrate does not contact the printing plate thereby increasing plate life and reducing abrasive wear. Also, the image on the plate is right for reading rather than reverse reading. Finally, less ink is required for equal coverage, drying is speeded, and smudging and setoff are reduced. Setoff is a

condition that results when wet ink on the surface of the press sheets transfers or sticks to the backs of other sheets in the delivery pile.

Thus, in summary, conventional lithographic offset printing machines or presses comprise one or more image printing stations each having a printing roller or a plate cylinder to which is fastened a thin hydrophilic, oleophobic printing plate having image areas which are oleophilic and hydrophobic and background areas which are oleophobic and hydrophilic. The plate surface is continuously wetted with an aqueous damping solution which adheres only to the background areas and inked with oleo-resinous inks which adhere only to the image areas of the plate as wet ink. The ink is offset transferred to the rubber surface of a contacting blanket cylinder and then retransferred to the receptive surface of a copy web or a succession of copy sheets, such as paper, with an impression cylinder and the ink air dries by oxidation and curing after passing through a drying station.

It is also known to provide the printing machine with a downstream coating station having a blanket roller associated with a coating application unit for the application of an overall protective coating over the entire printed area of the copy sheets or web.

It is known to apply pattern coatings of protective composition by means of blanket rolls by cutting into the rubber surface of the blanket to create raised or relief surface areas which selectively receive the coating composition from the application roll for retransfer to selected areas of the copy sheets in form of pattern coatings. See U.S. Pat. No. 4,796,556.

Lithographic inks are formulated to print from planographic surfaces which use the principle that grease and water do not mix. Lithographic inks are generally very strong in color value to compensate for the lesser amount applied. They are among the strongest of all inks. The average amount of ink transferred to the paper is about half that of letter press because of the double split of the ink film between the plate cylinder and the blanket cylinder and the blanket cylinder and the substrate on the impression cylinder.

Problems occur in the offset lithographic process when attempting to print certain colors such as white and in particular white on other colors such as yellow because the color white will be faint and not sufficiently strong. In such cases, the sheet or paper or substrate requiring the white ink usually has to be run through the same printer several times before the white becomes sufficiently strong.

Further, such colors are not generally printable in an offset lithographic printing process. This means that the sheets or substrate must be removed and transferred to a second type of machine using the flexographic process to apply greater amounts of ink in successive printing runs to achieve the desired print quality.

A like situation occurs with the printing of slurry-type materials such as "scratch-and-sniff" materials which is a liquid vehicle with a slurry containing an encapsulated essence. Such liquid vehicles, because of the nature of the slurry, must be printed with a flexographic process because the anilox roller can supply greater amounts of ink to the flexo plate on the plate cylinder.

Again, when a liquid vehicle with a slurry having suspended material therein such as metallic particles is to be printed, an offset lithographic process cannot be used without the mixing of the aqueous solution with metallic inks which cause a dulling of the image. Further, the above-mentioned double split of the ink film adds to the dulling of the image. Therefore, to achieve desired results, the printing must take place with a flexographic printing machine.

Thus, liquid opaque coatings or inks such as white colored ink, scratch-and-sniff vehicles, and slurries with metal particles do not achieve desired results when printed in an offset lithographic process and must be transferred from the offset lithographic in-line machines to a separate machine for printing in a separate run.

Such requirements not only hinder the speed of the printing process but also require additional time and thus increase the cost of the printing.

It would be advantageous to have a continuous in-line process in which not only offset lithographic printing could take place but in which, in the same in-line process, liquid printing vehicles including opaque coatings, such as white ink, and slurries containing encapsulated essences or metallic particles could also be printed and dried not only before the printing of the offset lithographic inks but also in which, after the liquid opaque coatings have been applied, an overcoating could be applied to the printed liquid vehicle image using the lithographic process in the continuous in-line process.

SUMMARY OF THE INVENTION

The present invention provides for a continuous in-line printing process having a plurality of successive printing stations for printing color images on a substrate. At least one of the stations prints a liquid vehicle image on a substrate with an opaque coating using the flexographic process and at least one of the successive printing stations printing a second color image over the liquid vehicle image on the printed substrate using the lithographic process in the continuous in-line process.

In the novel inventive system, a single in-line continuous printing process is used. One of the stations may print a liquid vehicle image on a substrate that contains a slurry with an encapsulated essence therein utilizing the flexographic process. Another one of the stations may apply an overcoating over the liquid vehicle image on the printed substrate using a lithographic process. Still another of the stations may print an aqueous-based vehicle image including a suspended metallic material therein using the flexographic process to form a metallic coating and thereafter at least one of the successive printing stations prints a color image over the aqueous-based vehicle image using the lithographic offset process in the continuous in-line process.

Whenever a station is used for flexographic printing, a flexographic plate image is placed on the blanket cylinder for receiving the liquid vehicle and transferring the liquid vehicle to the impression cylinder for printing. An anilox roller is associated with the flexographic plate for supplying the liquid vehicle which may be an aqueous-based vehicle.

In addition, in such case, a high-velocity air dryer is associated with the impression cylinder of one or more of the printing stations where the printing on the substrate is occurring to assist in drying the ink or liquid vehicle printed on the substrate while it is on or near the impression cylinder, before the substrate arrives at the next successive station for additional printing, or before printing occurs at the next successive station.

Thus, if a liquid vehicle such as white ink is to be printed, it is printed with a flexographic process which deposits a greater amount of ink on the substrate, the ink is dried with a high-velocity air dryer while the substrate is on or near the impression cylinder and prior to the substrate being received by the next successive station. If desired, at the next successive station the printing of the white liquid vehicle may again take place thus ensuring the desired intensity of

whiteness on the substrate. Subsequently, at the next succeeding station a printing may take place on top of the white printing and such printing may continue at the remaining successive stations.

Thus, it is an object of the present invention to provide a plurality of successive printing stations for printing color images on a substrate in a continuous in-line process and in which some of the stations print using the flexographic process and other of the stations print utilizing the offset lithographic process.

It is also an object of the present invention to print an aqueous-based vehicle image including a suspended metallic material therein using the flexographic process at one printing station and at least one successive printing station printing a color image over the aqueous-based vehicle image using a lithographic process in a continuous in-line process or placing an overcoating over the aqueous-based vehicle image using the flexographic process and then printing at successive stations using the lithographic process.

It is yet another object of the present invention to provide a continuous in-line printing process in which one of the stations prints a liquid vehicle image on the substrate with a slurry containing an encapsulated essence using the flexographic process and at least one of the successive printing stations applies an overcoating over the liquid vehicle image on the printed substrate using the offset lithographic process in a continuous in-line process.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other features of the present invention will be more fully disclosed when taken in conjunction with the following DETAILED DESCRIPTION OF THE PRESENT INVENTION in which like numerals represent like elements and in which:

FIG. 1 is a schematic view of a prior art offset lithography printing station;

FIG. 2 is a generalized depiction of a printing station that may be used either as an offset lithographic station or a flexographic printing station and illustrates how the station may be converted from an offset lithographic station to a flexographic station; and

FIG. 3 illustrates the continuous in-line process of the present invention comprising a plurality of printing stations, each of which can be converted from an offset lithographic printing station to a flexographic printing station as well as a final coating station.

DETAILED DESCRIPTION OF THE PRESENT INVENTION

FIG. 1 is a schematic representation of a well-known offset lithography printing station 10 having a plate cylinder 12, a blanket cylinder 14, and an impression cylinder 16. The printing medium or substrate, such as paper 20 either in sheet form or web, is fed over the impression cylinder 16 in printing contact with the blanket cylinder 14 to receive the image and then passes over the paper transfer cylinder 18 with the image printed thereon. An inking system 26, well known in the art, transfers the ink from the ink supply to the plate cylinder 12. This is a typical offset lithography printing station.

As disclosed in U.S. Pat. No. 4,796,556, offset lithographic printing machines generally have a plurality of in-line liquid application stations at least one of which is an ink image printing station for printing lithographic ink images on to suitable receptive copy sheets. The final

downstream liquid application station is a coating application station for printing a protective and/or aesthetic coating over selected portions of or over the entire ink-image printed surface of the copy sheets and can also be used to print metallic coatings or slurry. As stated in U.S. Pat. No. 4,796,556, two liquid application stations are shown, the latter including a coating apparatus and the first station being a conventional offset image printing station. The coating application printing station is one that can be modified to convert it either permanently or intermittently to a coating station from an offset lithographic station.

Such a station is illustrated in FIG. 2 herein. The station 30 comprises a housing 32 which includes therein a plate cylinder 34 that is fed with an ink system of rollers 36 that take ink from an ink supply 38 and transfer it to the plate cylinder 34. A blanket cylinder 40 is in ink transfer relationship with the plate cylinder 34 and the impression cylinder 42 where the image is transferred to a substrate passing between blanket cylinder 40 and impression cylinder 42 as blanket cylinder 40 rotates in the direction of arrow 52. This is a conventional offset lithographic printing station. When it is desired to convert that station into a coater station, the coater apparatus 43 has a coater head 44 including a supply of liquid coating and an anilox roller 46 that can be moved such that it can be in contact with either the blanket cylinder 40 for direct printing or the plate cylinder 34 for offset printing. In this case, the ink rollers 36 for the lithographic system are removed from engagement with the plate cylinder 34 in a well-known manner. The coater unit 43 includes a motor device 45, an arm 47, and a pivotal connection 48 that connects the coater head 44 with the remainder of the assembly.

As stated previously, the offset lithographic machine of FIG. 2 is converted as shown therein to a coater that is used only in the last stage of an in-line printing process. It has not been able to be used in stages other than the last printing station because the ink that is placed on the blanket cylinder by means of an anilox roller is still wet when it arrives at the subsequent stations, thus causing smearing of the printed material and causing a general impossibility of printing other information thereon. However, applicant has modified the station shown in FIG. 2 by the addition of a high-velocity air dryer 50 that is associated with the impression cylinder 42 directly after the ink is transferred from the blanket cylinder to the substrate on the impression cylinder. Thus by using flexographic inks, or aqueous coatings which are naturally quick-drying inks, and the high-velocity air dryer 50 located at the point where the ink is applied to the substrate on the impression cylinder, the ink is sufficiently dried when it passes to the next station that further printing can take place on the printed substrate.

Thus, as shown in FIG. 3, a conventional in-line offset lithographic printing machine 52 is shown having an apparatus to feed paper into the said machine, referred to as a feeder 54, printing stations 56, 58, 60, 62, and 64 and a coating station 66. A delivery station 68 receives the printed material or substrates. Thus there are a plurality of successive printing stations 56, 58, 60, 62, and 64 for printing color images on the substrate in a continuous in-line process. Any one of the printing stations 56–64 can be modified as generally shown therein and as illustrated in FIG. 2 to print a first color image using the flexographic process. The succeeding printing stations can then print a second color image over the first color image using the lithographic process in the continuous in-line process. As illustrated in FIG. 2, the flexographic process printing station includes the blanket cylinder 40 and the impression cylinder 42. A

flexographic plate 41 on the blanket cylinder 40 has an image thereon for receiving the first color from the anilox roller 46 and transferring that first color image to the impression cylinder 42 for printing on the substrate. The high-velocity air dryer 50 thus dries the flexographic ink on the substrate and passes the substrate to the subsequent printing station. Thus in FIG. 3, station 56 may be modified as generally shown therein and as illustrated in FIG. 2 and a flexographic ink can be printed thereon at station 56, dried by the high-velocity air dryer 50, and coupled to subsequent in-line stations 58–64 for further printing a second or more color images over the first color image using the offset lithographic process in a continuous in-line process. The flexographic printing station shown in FIG. 2 may print a liquid vehicle image on the substrate with a slurry containing an encapsulated essence. At at least one of the successive printing stations 58–64 an overcoating may be applied over the liquid vehicle image on the printed substrate using the flexographic process in the continuous in-line process. The overcoating may be an aqueous overcoating, or an ultraviolet overcoating. In addition, the substrate may be a sheet or a web 20 as illustrated in FIG. 1 or it may be single sheet fed in the continuous in-line process from the stack sheets shown at 54 in FIG. 3.

Further, the modified flexographic printing station 30 shown in FIG. 2, as stated previously, may be any one of the stations 56–64 in FIG. 3, and as illustrated by stations 56 and 58, and may print an aqueous-based vehicle image including a suspended metallic material therein using the flexographic process to form a metallic coating. Again, after it is dried by the high-velocity air dryer 50, it may be passed to one of the successive printing stations for printing a color image over the aqueous-based vehicle image using the offset lithographic process in the continuous in-line process. The suspended material may include uniform-sized metal particles to form the metallic coating or it may include nonuniform or multiple-sized metal particles to form the metallic coating.

The present invention is especially useful when a liquid opaque coating must be printed such as a white color ink. In that case, it may be desirable to have both stations 56 and 58 modified as shown in FIG. 3 and as illustrated in detail in FIG. 2. In such case, the anilox roller 46 at each station delivers the white ink in the same pattern to the flexographic plate 41 on the blanket cylinder 40 for transfer to the substrate on the impression cylinder 42. As the substrate passes the high-velocity drying station 50, the ink is dried and the second station may again print the same white pattern on the substrate to increase the quality of the white ink appearance after it is applied to the substrate.

Thus, the station or stations that are converted to flexographic printing stations may have an ink-providing means 46 at the printing station for applying a flexographic ink to the blanket cylinder to form the image. A substrate receives the flexographic ink image transfer from the blanket cylinder and at least one subsequent printing station in the in-line process receives the image-printed substrate and prints an additional coated ink image on the substrate on top of the flexographic ink image using offset lithography. The additional colored ink images that can be printed on top of the flexographic ink images can be conventional lithographic inks or waterless inks.

Further, the colored ink images may be printed with halftone screening processes. The flexographic ink image and the colored ink images may also be printed in solids and/or halftone printing plates in sequence and in registry in successive printing stations to produce a multicolored image on the substrate. Further, the printing apparatus may include a sheetfed press or a web press.

In the present invention, at least one of the flexographic printing stations prints an image with liquid vehicle slurry containing an encapsulated essence. In another embodiment, at least one of the printing stations prints an image with a water-based liquid vehicle containing suspended particles that are either uniform or nonuniform in size. The suspended particles may be metallic particles up to substantially 16 microns in diameter.

The present invention may also use the metallic color printing process as disclosed in commonly assigned U.S. Pat. No. 5,370,976 incorporated herein by reference in its entirety.

In one aspect, the novelty of the present invention is to create a flexographic printing station that can be used at one of a plurality of printing stations in a continuous in-line process and in which, at a subsequent printing station, a lithographic process may be used to print over the liquid vehicle printed by the flexographic station.

Thus, there has been disclosed an apparatus for a combined lithographic/flexographic printing process that includes a plurality of successive printing stations for printing color images on a substrate in a continuous in-line process and wherein one of the stations prints a first color image using the flexographic process and at least one of the successive printing stations prints a second color image over the first color image using the lithographic process in the continuous in-line process.

While the invention has been described in connection with a preferred embodiment, it is not intended to limit the scope of the invention to the particular form set forth, but, on the contrary, it is intended to cover such alternatives, modifications, and equivalents as may be included within the spirit and scope of the invention as defined by the appended claims.

We claim:

1. Apparatus for a combined lithographic/flexographic printing process comprising:

a substrate;

a plurality of successive printing stations for printing color images on the substrate in a continuous in-line process;

one of said stations comprising a flexographic printing station for printing a liquid vehicle image on said substrate with a slurry containing an encapsulated essence using the flexographic process;

at least one of said successive printing stations being a lithographic printing station; and

an overcoating applied over the liquid vehicle image on the printed substrate at at least one of said successive lithographic printing stations using the lithographic process in said continuous in-line process.

2. Apparatus as in claim 1 wherein said overcoating is an aqueous overcoating.

3. Apparatus as in claim 1 wherein said overcoating is an ultraviolet ink overcoating.

4. Apparatus as in claim 1 wherein:

said substrate is a paper sheet; and

said apparatus includes a sheet feeder.

5. Apparatus as in claim 1 wherein:

said substrate is a web; and

said apparatus includes a web feeder.

6. Apparatus for a combined lithographic/flexographic printing process comprising:

a plurality of successive printing stations for printing color images on a substrate in a continuous in-line process;

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one of said stations comprising a flexographic printing station printing an aqueous-based vehicle image using the flexographic process to form a metallic coating;

a suspended metallic material being included in said aqueous-based vehicle image; and

at least one of the successive printing stations comprising an offset lithographic printing station printing a color image over the aqueous-based vehicle image using the offset lithographic process in said continuous in-line process.

7. Apparatus as in claim 6 wherein said suspended material includes uniform-sized metal particles to form said metallic coating.

8. Apparatus as in claim 6 wherein said suspended material includes nonuniform-sized metal particles to form said metallic coating.

9. Apparatus as in claim 6 further including: said flexographic printing station including a plate cylinder having a flexographic plate thereon, a blanket cylinder, and an impression cylinder;

a flexographic plate image transferred from said plate cylinder to said blanket cylinder, said image being formed of said metallic coating, said blanket cylinder transferring said metallic coating to said impression cylinder for printing said flexographic plate image on said substrate; and

an anilox roller associated with said flexographic plate for supplying said aqueous-based vehicle containing said suspended metallic material to said flexographic plate.

10. Apparatus for creating a combined lithographic/flexographic printing process comprising:

a plurality of successive printing stations for printing color images on a substrate in a continuous in-line process;

one of said stations comprising a flexographic printing station for printing a first color image using the flexographic process; and

at least one of the successive printing stations comprising an offset lithographic printing station for printing a second color image over the first color image using the offset lithographic process in said continuous in-line process.

11. Apparatus as in claim 10 further including:

said flexographic printing station including a plate cylinder, a blanket cylinder, and an impression cylinder;

a flexographic plate on said plate cylinder;

an anilox roller associated with said flexographic plate for supplying a first color to said flexographic plate to form said first color image; and

said blanket cylinder receiving said first color image from said plate cylinder and transferring said first color image to said impression cylinder for printing on said substrate.

12. Apparatus for creating a combined lithographic/flexographic printing process comprising:

a substrate;

a plurality of successive printing stations for printing color images on the substrate in a continuous in-line process;

at least two successive ones of said printing stations being flexography stations and comprising:

(1) a supply of liquid coating;

(2) a plate cylinder associated with a blanket cylinder, said plate cylinder having a flexographic plate thereon;

(3) an anilox roller associated with said liquid supply coating and said plate cylinder for delivering said liquid coating to said flexographic plate to form an image for transfer to said blanket cylinder;

(4) an impression cylinder for receiving said liquid coating image transferred from said blanket cylinder and printing said image on said substrate, said at least two flexography stations printing the same liquid coating image in sequence and in superimposed relationship; and

at least one offset lithographic printing station for receiving said substrate and printing over said liquid coating image.

13. Apparatus as in claim 12 wherein said liquid coating image printed on said substrate is a white color ink.

14. Apparatus as in claim 12 further including an air dryer associated with each of said impression cylinders on said flexography stations, said air dryer having sufficient air velocity for drying said liquid coating before the substrate is transferred to the successive printing station in said continuous in-line process.

15. Apparatus for a combined lithographic/flexographic printing process comprising:

a plurality of successive printing stations for printing color images on a substrate in a continuous in-line process, said printing stations including both lithographic and flexographic printing stations;

a blanket cylinder at at least a first one of said flexographic printing stations;

flexographic ink-providing means at said at least first one of said flexographic printing stations for applying a flexographic ink to said blanket cylinder to form an image;

a substrate for receiving said flexographic ink image transferred from said blanket cylinder; and

at least one subsequent lithographic printing station in said in-line process for receiving said image printed substrate and printing an additional colored ink image on said substrate on top of said flexographic ink image using offset lithography.

16. Apparatus as in claim 15 further comprising:

a plate cylinder at said at least first one of said flexographic stations;

a flexographic plate on said plate cylinder for receiving and transferring said flexographic ink to said blanket cylinder; and

said flexographic ink-providing means including a flexographic ink supply and an anilox roller associated with said flexographic ink supply for transferring said flexographic ink to said flexographic plate.

17. Apparatus for a combined lithographic/flexographic printing process for printing a multicolored image comprising:

a plurality of successive printing stations for printing color on a substrate in a continuous in-line process, said printing stations including both lithographic and flexographic printing stations;

at least one of said flexographic printing stations having:

(1) a plate cylinder and a blanket cylinder, said plate cylinder including a flexographic plate having an image thereon for transferring a flexographic color ink image to said blanket cylinder;

(2) an etched anilox roller for applying a flexographic color ink to said flexographic plate on said plate cylinder;

(3) an impression cylinder in ink-transfer relationship with said blanket cylinder for transferring said flexographic color ink image from said blanket cylinder to said substrate; and

at least one of said succeeding printing stations being a lithographic printing station using offset lithography for printing additional colored ink images on top of said flexographic ink image.

18. Apparatus as in claim 17 wherein said additional colored ink images are formed with lithographic inks.

19. Apparatus as in claim 17 wherein said colored ink images are formed with waterless inks.

20. Apparatus as in claim 17 further including an air dryer adjacent to said impression cylinder for drying the flexographic ink image transferred to said substrate before said additional colored ink images are printed thereon.

21. Apparatus as in claim 17 further including halftone printing plates for printing said colored ink images.

22. Apparatus as in claim 17 wherein said flexographic ink image and said colored ink images are printed as solid colors and/or with halftone printing plates in sequence and in registry in said successive printing stations to produce said multicolored image on said substrate.

23. Apparatus as in claim 17 wherein said printing apparatus includes a sheet-fed press.

24. Apparatus as in claim 17 wherein at least one of said flexographic printing stations prints said flexographic ink image with liquid vehicle slurry containing an encapsulated essence.

25. Apparatus as in claim 17 wherein at least one of said printing stations prints said flexographic ink image with a water-based liquid vehicle containing suspended particles.

26. Apparatus as in claim 25 wherein said suspended particles are uniform in size.

27. Apparatus as in claim 25 wherein said suspended particles are nonuniform in size.

28. Apparatus as in claim 25 wherein said suspended particles are metallic particles.

29. A method of combining lithography and flexographic printing in a continuous in-line process comprising the steps of:

providing a plurality of successive lithographic/flexographic printing stations for printing colored ink images on a substrate;

printing a flexographic ink image on said substrate at at least one of said flexographic stations;

transferring said printed substrate to at least one subsequent printing station in said continuous in-line process; and

printing colored ink images on top of said flexographic ink image at at least one of said subsequent lithographic printing stations with an offset lithographic process.

30. A method as in claim 29 further comprising the step of drying said flexographic ink image on said substrate with an air dryer prior to printing said colored ink images thereon.

31. A method as in claim 29 further including the step of printing a coating on top of said colored ink images at one of said plurality of subsequent printing stations.

32. A method as in claim 29 wherein said colored inks forming said colored ink images are waterless.

33. A method as in claim 29 wherein said colored inks forming said colored ink images are in a solvent-based liquid vehicle.

34. A method as in claim 29 further including the steps of:

printing a slurry on said substrate at any of said printing stations in said continuous in-line process;

using an encapsulated essence in said slurry; and

printing an overcoating over said slurry at a subsequent printing station in said in-line process to protect said essence.

35. A method as in claim 34 further including the step of printing an aqueous-based coating over said slurry.

36. A method as in claim 34 further including the step of printing an ultraviolet coating over said slurry.

37. A method of combining offset lithography and flexographic printing in a continuous in-line process comprising the steps of:

providing a substrate;

applying a flexographic ink to a blanket cylinder in a pattern with a coating head at a first flexographic printing station;

transferring said pattern of flexographic ink from said blanket cylinder to the substrate; and

printing a waterless ink pattern over said flexographic ink pattern on said substrate at at least one subsequent offset lithographic printing station in said continuous in-line process.

38. A method of combining lithography and flexographic printing in a continuous in-line process comprising the steps of:

printing an aqueous-based vehicle image having suspended particles therein on a substrate at a first flexographic printing station;

transferring said image printed substrate to at least one additional printing station in said continuous in-line process; and

printing additional colored ink images on said printed substrate over said aqueous-based vehicle image in an offset lithographic process at said at least one additional printing station in said in-line process.

39. A method of combining lithography and flexographic printing in a continuous in-line process comprising the steps of:

(1) providing a plurality of successive printing stations for printing liquid vehicle images on a substrate in said in-line continuous process;

(2) utilizing an anilox roller to transfer a liquid ink as said liquid vehicle to a flexographic plate image at at least one of said printing stations;

(3) printing said liquid ink from said flexographic plate image to a substrate;

(4) transferring said printed substrate with said liquid ink image to a subsequent printing station in said in-line printing process;

(5) repeating steps (2)–(4) at subsequent printing stations in said in-line process to achieve a desired opacity ink image on said substrate; and

(6) printing an ink pattern over said flexographic ink image using an offset lithographic process.

40. A method as in claim 39 further including the step of additionally printing colored ink images over said liquid ink image on said substrate at subsequent ones of said printing stations in said in-line process.

41. A method as in claim 40 wherein said liquid ink is an opaque white color.

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Reissue of U. S. Patent No. 5,630,363

CLAIMS

Note: Bracketed material in the following claims has been deleted from U. S. Patent 5,630,363 as issued; underlined materials, including new claims 42-84 has been added.

1. Apparatus for a combined lithographic/flexographic printing process comprising:

a substrate;

a plurality of successive printing stations for printing color images on the substrate in a continuous in-line process;

one of said stations comprising a flexographic printing station for printing a liquid vehicle image on said substrate with a slurry containing an encapsulated essence using the flexographic process;

at least one of said successive printing stations being a lithographic printing station; and

an overcoating applied over the liquid vehicle image on the printed substrate at at least one of said successive lithographic printing stations using the lithographic process in said continuous in-line process.

2. Apparatus as in claim 1 wherein said overcoating is an aqueous overcoating.

3. Apparatus as in claim 1 wherein said overcoating is an ultraviolet ink overcoating.

4. Apparatus as in claim 1 wherein:

said substrate is a paper sheet; and

said apparatus includes a sheet feeder.

5. Apparatus as in claim 1 wherein:

said substrate is a web; and

said apparatus includes a web feeder.

6. Apparatus for a combined lithographic/flexographic printing process comprising:

a plurality of successive printing stations for printing color images on a substrate in a continuous in-line process;

one of said stations comprising a flexographic printing station printing an aqueous-based vehicle image using the flexographic process to form a metallic coating;

a suspended metallic material being included in said aqueous-based vehicle image; and

at least one of the successive printing stations comprising an offset lithographic printing station printing a color image over the aqueous-based vehicle image using the offset lithographic process in said continuous in-line process.

7. Apparatus as in claim 6 wherein said suspended material includes uniform-sized metal particles to form said metallic coating.

8. Apparatus as in claim 6 wherein said suspended material includes nonuniform-sized metal particles to form said metallic coating.

9. Apparatus as in claim 6 further including: said flexographic printing station including a plate cylinder having a flexographic plate thereon, a blanket cylinder, and an impression cylinder;

a flexographic plate image transferred from said plate cylinder to said blanket cylinder, said image being formed of said metallic coating, said blanket cylinder transferring said metallic coating to said impression

cylinder for printing said flexographic plate image on said substrate; and

an anilox roller associated with said flexographic plate for supplying said aqueous-based vehicle containing said suspended metallic material to said flexographic plate.

10. Apparatus for creating a combined lithographic/flexographic printing process comprising:

a plurality of successive printing stations for printing color images on a substrate in a continuous in-line process;

one of said stations comprising a flexographic printing station for printing a first color image using the flexographic process; and

at least one of the successive printing stations comprising an offset lithographic printing station for printing a second color image over the first color image using the offset lithographic process in said continuous in-line process.

11. Apparatus as in claim 10 further including:

said flexographic printing station including a plate cylinder, a blanket cylinder, and an impression cylinder;

a flexographic plate on said plate cylinder;

an anilox roller associated with said flexographic plate for supplying a first color to said flexographic plate to form said first color image; and

said blanket cylinder receiving said first color image from said plate cylinder and transferring said first color image to said impression cylinder for printing on said substrate.

12. Apparatus for creating a combined lithographic/flexographic printing process comprising:

a substrate;

a plurality of successive printing stations for printing color images on the substrate in a continuous in-line process;

at least two successive ones of said printing stations being flexography stations and comprising:

(1) a supply of liquid coating;

(2) a plate cylinder associated with a blanket cylinder, said plate cylinder having a flexographic plate thereon;

(3) an anilox roller associated with said liquid supply coating and said plate cylinder for delivering said liquid coating to said flexographic plate to form an image for transfer to said blanket cylinder;

(4) an impression cylinder for receiving said liquid coating image transferred from said blanket cylinder and printing said image on said substrate, said at least two flexography stations printing the same liquid coating image in sequence and in superimposed relationship; and

at least one offset lithographic printing station for receiving said substrate and printing over said liquid coating image.

13. Apparatus as in claim 12 wherein said liquid coating image printed on said substrate is a white color ink.

14. Apparatus as in claim 12 further including an air dryer associated with each of said impression cylinders on said flexography stations, said air dryer having sufficient air velocity for drying said liquid coating before the substrate is transferred to the successive printing station in said continuous in-line process.

15. Apparatus for a combined lithographic/flexographic printing process comprising:

a plurality of successive printing stations for printing color images on a substrate in a continuous in-line process, said printing stations including both lithographic and flexographic printing stations;

a blanket cylinder at at least a first one of said flexographic printing stations;

flexographic ink-providing means at said at least first one of said flexographic printing stations for applying a flexographic ink to said blanket cylinder to form an image;

a substrate for receiving said flexographic ink image transferred from said blanket cylinder; and

at least one subsequent lithographic printing station in said in-line process for receiving said image printed substrate and printing an additional colored ink image on said substrate on top of said flexographic ink image using offset lithography.

16. Apparatus as in claim 15 further comprising:

a plate cylinder at said at least first one of said flexographic stations;

a flexographic plate on said plate cylinder for receiving and transferring said flexographic ink to said blanket cylinder; and

said flexographic ink-providing means including a flexographic ink supply and an anilox roller associated with said flexographic ink supply for transferring said flexographic ink to said flexographic plate.

17. Apparatus for a combined lithographic/ flexographic printing process for printing a multicolored image comprising:

a plurality of successive printing stations for printing color on a substrate in a continuous in-line process, said printing stations including both lithographic and flexographic printing stations;

at least one of said flexographic printing stations having:

(1) a plate cylinder and a blanket cylinder, said plate cylinder including a flexographic plate having an

image thereon for transferring a flexographic color ink image to said blanket cylinder;

(2) an etched anilox roller for applying a flexographic color ink to said flexographic plate on said plate cylinder;

(3) an impression cylinder in ink-transfer relationship with said blanket cylinder for transferring said flexographic color ink image from said blanket cylinder to said substrate; and

at least one of said succeeding printing stations being a lithographic printing station using offset lithography for printing additional colored ink images on top of said flexographic ink image.

18. Apparatus as in claim 17 wherein said additional colored ink images are formed with lithographic inks.

19. Apparatus as in claim 17 wherein said colored ink images are formed with waterless inks.

20. Apparatus as in claim 17 further including an air dryer adjacent to said impression cylinder for drying the flexographic ink image transferred to said substrate before said additional colored ink images are printed thereon.

21. Apparatus as in claim 17 further including halftone printing plates for printing said colored ink images.

22. Apparatus as in claim 17 wherein said flexographic ink image and said colored ink images are printed as solid colors and/or with halftone printing plates in sequence and in registry in said successive printing stations to produce said multicolored image on said substrate.

23. Apparatus as in claim 17 wherein said printing apparatus includes a sheet-fed press.

24. Apparatus as in claim 17 wherein at least one of said flexographic printing stations prints said flexographic ink image with liquid vehicle slurry containing an encapsulated essence.

25. Apparatus as in claim 17 wherein at least one of said printing stations prints said flexographic ink image with a water-based liquid vehicle containing suspended particles.

26. Apparatus as in claim 25 wherein said suspended particles are uniform in size.

27. Apparatus as in claim 25 wherein said suspended particles are nonuniform in size.

28. Apparatus as in claim 25 wherein said suspended particles are metallic particles.

29. A method of combining lithography and flexographic printing in a continuous in-line process comprising the steps of:

providing a plurality of successive lithographic/flexographic printing stations for printing colored ink images on a substrate;

printing a flexographic ink image on said substrate at at least one of said flexographic stations;

transferring said printed substrate to at least one subsequent printing station in said continuous in-line process; and

printing colored ink images [on top of] over said flexographic ink image at at least one of said subsequent lithographic printing stations with an offset lithographic process.

30. A method as in claim 29 further comprising the step of drying said flexographic ink image on said substrate with an air dryer prior to printing said colored ink images thereon.

31. A method as in claim 29 further including the step of printing a coating on top of said colored ink images at one of said plurality of subsequent printing stations.

32. A method as in claim 29 wherein said colored inks forming said colored ink images are waterless.

33. A method as in claim 29 wherein said colored inks forming said colored ink images are in a solvent-based liquid vehicle.

34. A method as in claim 29 further including the steps of:

printing a slurry on said substrate at any of said printing stations in said continuous in-line process;

using an encapsulated essence in said slurry; and

printing an overcoating [over] on top of said slurry at a subsequent printing station in said in-line process to protect said essence.

35. A method as in claim 34 further including the step of printing an aqueous-based coating over said slurry.

36. A method as in claim 34 further including the step of printing an ultraviolet coating over said slurry.

37. A method of combining offset lithography and flexographic printing in a continuous in-line process comprising the steps of:

providing a substrate;

applying a flexographic ink to a blanket cylinder in a pattern with a coating head at a first flexographic printing station;

transferring said pattern of flexographic ink from said blanket cylinder to the substrate; and

printing a waterless ink pattern over said flexographic ink pattern on said substrate at at least one subsequent offset lithographic printing station in said continuous in-line process.

38. A method of combining lithography and flexographic printing in a continuous in-line process comprising the steps of:

printing an aqueous-based vehicle image having suspended particles therein on a substrate at a first flexographic printing station;

transferring said image printed substrate to at least one additional printing station in said continuous in-line process; and

printing additional colored ink images on said printed substrate over said aqueous-based vehicle image in an offset lithographic process at said at least one additional printing station in said in-line process.

39. A method of combining lithography and flexographic printing in a continuous in-line process comprising the steps of:

(1) providing a plurality of successive printing stations for printing liquid vehicle images on a substrate in said in-line continuous process;

(2) utilizing an anilox roller to transfer a liquid ink as said liquid vehicle to a flexographic plate image at at least one of said printing stations;

(3) printing said liquid ink from said flexographic plate image to a substrate;

(4) transferring said printed substrate with said liquid ink image to a subsequent printing station in said in-line printing process;

(5) repeating steps (2)-(4) at subsequent printing stations in said in-line process to achieve a desired opacity ink image on said substrate; and

(6) printing an ink pattern over said flexographic ink image using an offset lithographic process.

40. A method as in claim 39 further including the step of additionally printing colored ink images over said liquid ink image on said substrate at subsequent ones of said printing stations in said in-line process.

41. A method as in claim 40 wherein said liquid ink is an opaque white color.

42. The apparatus of any of claims 1, 6, 10, 12, 15 and 17, wherein the substrate is printed on both sides in one pass during the continuous in-line process.

43. The method of any of claims 29, 37, 38 or 39 wherein the substrate is printed on both sides in one pass during the continuous in-line process.

44. Apparatus for a combined lithographic/flexographic printing process comprising:

a substrate;

a plurality of successive printing stations for depositing a series of thin, controlled layers on one side of a substrate in a continuous in-line process;

one of said stations comprising a flexographic printing station for printing a liquid vehicle image on said substrate using a flexographic process; and

at least one of said successive printing stations being a lithographic printing station;

whereby said substrate is printed on top of or on the opposite side of that previously printed at at least one of said successive lithographic printing stations using the lithographic process in said continuous in-line process.

45. Apparatus as in claim 44 wherein at least one of said thin, controlled layers at the flexographic station is a coating material.

46. Apparatus as in claim 44 wherein at least one of said thin, controlled layers at one of the lithographic stations is an ink.

47. Apparatus as in claim 44 wherein:

said substrate is a paper sheet; and

said apparatus includes a sheet feeder.

48. Apparatus as in claim 44 wherein:

said substrate is a web; and

said apparatus includes a web feeder.

49. The apparatus of claim 44 for a combined lithographic/flexographic printing process comprising:

a plurality of successive printing stations for depositing a series of thin, controlled layers on a substrate in a continuous in-line process;

one of said stations comprising a flexographic printing station printing an aqueous-based vehicle on one side of the substrate using the flexographic process to form a metallic coating image;

a suspended metallic material being included in said aqueous-based vehicle; and

at least one of the successive printing stations comprising an offset lithographic printing station printing a color image on top of the aqueous-based vehicle or on the opposite side to that previously printed using the offset lithographic process in said continuous in-line process.

50. Apparatus as in claim 49 wherein said suspended material includes uniform-sized metal particles to form said metallic coating.

51. Apparatus as in claim 49 wherein said suspended material includes nonuniform-sized metal particles to form said metallic coating.

52. Apparatus as in claim 49 further including: said flexographic printing station including a plate cylinder having a flexographic plate thereon, a blanket cylinder, and an impression cylinder;

a flexographic plate image transferred from said plate cylinder to said blanket cylinder, said image being formed of said metallic coating, said blanket cylinder transferring said metallic coating to said impression cylinder for printing said flexographic plate image on said substrate; and

an anilox roller associated with said flexographic plate for supplying said aqueous-based vehicle containing said suspended metallic material to said flexographic plate.

53. Apparatus for creating a combined lithographic/flexographic printing process comprising:

a plurality of successive printing stations for depositing a series of thin, controlled layers on a substrate in a continuous in-line process;

one of said stations comprising a flexographic printing station for printing a first color image using the flexographic process; and

at least one of the other successive printing stations comprising an offset lithographic printing station for printing a second color image on the reverse side of the substrate of the first color image using the offset lithographic process in said continuous in-line process.

54. Apparatus as in claim 53 further including:

said flexographic printing station including a plate cylinder, a blanket cylinder, and an impression cylinder;

a flexographic plate on said plate cylinder;

an anilox roller associated with said flexographic plate for supplying a first color to said flexographic plate to form said first color image; and

said blanket cylinder receiving said first color image from said plate cylinder and transferring said first color image to said impression cylinder for printing on said substrate.

55. Apparatus for creating a combined lithographic/flexographic printing process comprising:

a substrate;

a plurality of successive printing stations for depositing a series of thin, controlled layers on a substrate in a continuous in-line process;

at least one of said printing stations being flexographic stations and comprising:

(1) a supply of liquid coating;

(2) a plate cylinder associated with a blanket cylinder, said plate cylinder having a flexographic plate thereon;

(3) an anilox roller associated with said liquid supply coating and said plate cylinder for delivering said liquid coating to said flexographic plate to form an image for transfer to said blanket cylinder;

(4) an impression cylinder for receiving said liquid coating image transferred from said blanket cylinder and printing said image on one side of said substrate; and

at least one offset lithographic printing station for receiving said substrate and printing on top of or on the opposite side to that previously printed.

56. Apparatus as in claim 55 wherein said liquid coating image printed on said substrate is a white color ink.

57. Apparatus as in claim 56 further including an air dryer associated with each of said impression cylinders on said flexography stations, said air dryer having sufficient air velocity for drying said liquid coating before the substrate is transferred to the successive printing station in said continuous in-line process.

58. Apparatus for a combined lithographic/ flexographic printing process comprising:

a plurality of successive printing stations for depositing a series of thin, controlled layers on a substrate in a continuous in-line process, said printing stations including both lithographic and at least two flexographic printing stations;

a blanket cylinder at at least a first one of said flexographic printing stations;

flexographic ink-providing means at the other of said flexographic printing stations for applying a flexographic ink to said blanket cylinder to form an image on one side of a substrate;

a substrate for receiving said flexographic ink image transferred from said blanket cylinder; and

at least one subsequent lithographic printing station in said in-line process for receiving said image printed substrate and printing an additional colored ink image on said substrate on top of said flexographic ink image or the opposite side to that previously printed using offset lithography.

59. Apparatus as in claim 58 further comprising:

a plate cylinder at said at least first one of said flexographic stations;

a flexographic plate on said plate cylinder for receiving and transferring said flexographic ink to said blanket cylinder; and

said flexographic ink-providing means including a flexographic ink supply and an anilox roller associated with said flexographic ink supply for transferring said flexographic ink to said flexographic plate.

60. Apparatus for a combined lithographic/ flexographic printing process for printing a multicolored image comprising:

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a plurality of successive printing stations for depositing a series of thin, controlled layers on a substrate in a continuous in-line process, said printing stations including both lithographic and flexographic printing stations;

at least one of said flexographic printing stations having:

(1) a plate cylinder and a blanket cylinder, said plate cylinder including a flexographic plate having an image thereon for transferring a flexographic color ink image to said blanket cylinder;

(2) an etched anilox roller for applying a flexographic color ink to said flexographic plate on said plate cylinder;

(3) an impression cylinder in ink-transfer relationship with said blanket cylinder for transferring said flexographic color ink image from said blanket cylinder to one side of said substrate; and

at least one of said succeeding printing stations being a lithographic printing station using offset lithography for printing additional colored ink images on top of said flexographic ink image or on the opposite side to that that previously printed.

61. Apparatus as in claim 60 wherein said additional colored ink images are formed with lithographic inks.

62. Apparatus as in claim 60 wherein said colored ink images are formed with waterless inks.

63. Apparatus as in claim 60 further including an air dryer adjacent to said impression cylinder for drying the flexographic ink image transferred to said substrate before said additional colored ink images are printed thereon.

64. Apparatus as in claim 60 further including halftone printing plates for printing said colored ink images.

65. Apparatus as in claim 60 wherein said flexographic ink image and said colored ink images are printed as solid colors and/or with halftone printing plates in sequence and in registry in said successive printing stations to produce said multicolored image on said substrate.

66. Apparatus as in claim 60 wherein said printing apparatus includes a sheet-fed press.

67. Apparatus as in claim 60 wherein at least one of said flexographic printing stations prints said flexographic ink image with liquid vehicle slurry containing an encapsulated essence.

68. Apparatus as in claim 60 wherein at least one of said printing stations prints said flexographic ink image with a water-based liquid vehicle containing suspended particles.

69. Apparatus as in claim 68 wherein said suspended particles are uniform in size.

70. Apparatus as in claim 68 wherein said suspended particles are nonuniform in size.

71. Apparatus as in claim 68 wherein said suspended particles are metallic particles.

72. A method of combining lithography and flexographic printing in a continuous in-line process comprising the steps of:

providing a plurality of successive lithographic/flexographic printing stations for depositing a series of thin, controlled layers on a substrate;

printing an image as one of said thin controlled layers on one side of said substrate at at least one of said flexographic stations;

transferring said printed substrate to at least one subsequent printing station in said continuous in-line process; and

printing an image on the reverse side of said substrate having said flexographic ink image, at at least one of said other subsequent lithographic printing stations with an offset lithographic process in the continuous in-line process.

73. A method as in claim 72 further comprising the step of drying said flexographic ink image on said substrate with an air dryer prior to printing said colored ink images thereon.

74. A method as in claim 72 further including the step of printing a coating on top of said colored ink images at one of said plurality of subsequent printing stations.

75. A method as in claim 72 wherein said colored inks forming said colored ink images are waterless.

76. A method as in claim 72 wherein said colored inks forming said colored ink images are in a solvent-based liquid vehicle.

77. A method as in claim 72 further including the steps of:

printing a slurry on one side of said substrate at any of said printing stations in said continuous in-line process;

using an encapsulated essence in said slurry; and

printing an ink on the reverse side of said substrate at a subsequent printing station in said in-line process.

78. A method as in claim 77urther including the step of printing an aqueous-based coating over said slurry.

79. A method as in claim 77 further including the step of printing an ultraviolet coating over said slurry.

80. A method of combining offset lithography and flexographic printing in a continuous in-line process comprising the steps of:

providing a substrate;

applying an ink or coating to a blanket cylinder in a pattern with a coating head at a flexographic printing station;

transferring said pattern of ink or coating from said blanket cylinder to one side of the substrate; and

printing a waterless ink pattern on the reverse side of said substrate at at least one subsequent offset lithographic printing station in said continuous in-line process.

81. A method of combining lithography and flexographic printing in a continuous in-line process comprising the steps of:

printing an aqueous-based vehicle having suspended particles therein on one side of a substrate at a flexographic printing station to form an image;

transferring said image printed substrate to at least one additional printing station in said continuous in-line process; and

printing additional images on the reverse side of said printed substrate in an offset lithographic process at said at least one additional printing station in said in-line process.

82. A method of combining lithography and flexographic printing in a continuous in-line process comprising the steps of:

(1) providing a plurality of successive printing stations for depositing a series of thin, controlled layers on a substrate in said in-line continuous process;

(2) utilizing an anilox roller to transfer a liquid ink as one of said thin controlled layers to a flexographic plate image at at least one of said printing stations;

(3) printing said liquid ink from said flexographic plate image to one side of a substrate;

(4) transferring said printed substrate with said liquid ink image to a subsequent printing station in said in-line printing process;

(5) repeating steps (2)-(4) at subsequent printing stations in said in-line process to achieve a desired opacity ink image on the one side of said substrate; and

(6) printing an ink pattern on the reverse side of said substrate using an offset lithographic process.

83. A method as in claim 82 further including the step of additionally printing ink images over said liquid ink image on said substrate at subsequent ones of said printing stations in said in-line process.

84. A method as in claim 83 wherein said liquid ink is an opaque white color.

85. A method of combining offset lithography and flexography using a plurality of successive printing stations in a continuous in-line process comprising:

(1) printing an image at one or more of said printing stations on a substrate using an offset lithographic process;

(2) transferring said image printed substrate to an additional printing station and printing at said additional printing station a coating on all or part of said image on said substrate;

(3) transferring said substrate to one or more additional printing stations for printing the reverse side of the said substrate; and

(4) printing an image on said reverse side of said substrate at one of such one or more printing stations using an offset lithographic process in the continuous in-line process.

86. Apparatus for a combined offset lithographic and flexographic printing process comprising:

(1) a substrate;

(2) a plurality of successive printing stations for depositing a series of thin layers of materials selected from a group consisting of lithographic and flexographic inks, coatings and slurries on one or both sides of a substrate in a continuous in-line process;

(3) at least one of said stations comprising a flexographic printing station for printing one of said flexographic materials on said substrate using a flexographic process;

(4) at least one of said successive printing stations being an offset lithographic printing station whereby said offset lithographic printing station is used to deposit one of said lithographic materials on either side of the said substrate in the continuous in-line process;

87. Apparatus for a combined offset lithographic/flexographic printing process comprising:

a plurality of successive printing stations for printing images on a substrate in a continuous in-line process, said printing stations including both offset lithographic and flexographic printing stations for depositing lithographic and flexographic inks, coatings and slurries on said substrate, whereby said lithographic and flexographic inks, coatings or slurries may be printed successively on one or both sides of said substrate in the continuous in-line process.

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IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF TEXAS
DALLAS DIVISION

20 1999

CLERK

By

PRINTING RESEARCH, INC., and HOWARD W. DEMOORE, Plaintiffs, v. WILLIAMSON PRINTING CORPORATION BILL L. DAVIS, and JESSE S. WILLIAMSON, Defendant.	§ § § § § § § § § § § §	Civil Action No. ____ 3-99CV1154-D

ORIGINAL COMPLAINT

Plaintiffs, Printing Research, Inc. and Howard W. DeMoore (collectively "Plaintiffs"), file this Complaint against Defendants Williamson Printing Corporation, Bill L. Davis, and Jesse S. Williamson (collectively "Defendants"), and for their causes of action would show the Court the following:

PARTIES

1. Plaintiff Printing Research, Inc. ("PRI") is a corporation organized and existing under the laws of the State of Texas and has its principle place of business at 10954 Shady Trail, Dallas, Texas 75220.

2. Plaintiff Howard W. DeMoore ("DeMoore") is an individual with a business address of 10954 Shady Trail, Dallas, Texas 75220.

3. On information and belief, Defendant Williamson Printing Corporation ("WPC") is a corporation organized and existing under the laws of the State of Texas and has its principal

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place of business at 6700 Denton Drive, Dallas, Texas 75235, and may be served through its registered agent at the following address:

Jerry B. Williamson
6700 Denton Drive
Dallas, Texas 75235

4. On information and belief, Defendant Bill L. Davis ("Davis") is an individual residing at 1126 Tipton Road, Irving, Texas 75060, where he may be served with service of process.

5. On information and belief, Defendant Jesse S. Williamson ("Williamson") is an individual residing at 5738 Caruth Boulevard, Dallas, Texas 75209, where he may be served with service of process.

JURISDICTION

6. This is an action arising under the patent laws of the United States (Title 35 United States Code), to correct the designation of inventorship which currently appears on United States Patent No. 5,630,363 ("the '363 patent) under 35 U.S.C. § 256 (Count I). Additionally, this action is brought to obtain relief from the infringement of the '363 patent under 35 U.S.C. § 271 (Count II), and to recover attorneys' fees for this action under 35 U.S.C. § 285 (Count VI). Subject matter jurisdiction is therefore proper in this Court under 28 U.S.C. § 1338. Venue is proper in this Court under 28 U.S.C. § 1391(b), (c) and 1400(b).

7. This Court has supplemental jurisdiction under 28 U.S.C. §1367 as to all other causes of action alleged herein (Counts III, IV, and V).

8. On information and belief, Davis and Williamson reside in this District, and WPC maintains its primary place of business in this District. Accordingly, Defendants may be served within this District and are properly subject to the personal jurisdiction of this Court.

BACKGROUND

9. DeMoore has developed, marketed, and sold innovative equipment and supplies for the printing industry for over thirty years, and currently serves as Chairman of PRI, a corporation dedicated to supply such equipment and supplies to printers across the globe.

10. During 1994 and 1995, building upon his prior work with lithographic and flexographic printing technology, DeMoore conceived and developed a single-pass printing process and apparatus having successive printing stations for selectively applying printing inks and coatings to paper and other substrates, in which one of the stations utilizes a flexographic process and at least one of the successive stations utilizes a lithographic process. DeMoore and PRI termed this new invention the "Lithoflex" system. DeMoore and PRI developed a commercial apparatus, termed a printer/coater unit, for use with existing printing presses, which would allow those printing presses to utilize the Lithoflex system. PRI is licensed under all of DeMoore's rights to the inventions represented by the Lithoflex system and the printer/coater unit.

11. In October of 1994, Plaintiffs tested certain flexographic coating technology using a two-color Heidelberg lithographic press (the "pilot press") located at a PRI facility. The testing produced samples (the "flexographic samples") illustrating potential applications of that technology. Soon thereafter, DeMoore conceived and began development of the Lithoflex system, in which flexographic coating technology was incorporated within a single-pass press having downstream lithographic printing stations.

12. WPC is today, and was in 1994, a provider of commercial printing services. In 1994, WPC possessed and utilized a Heidelberg CD multi-color press at its Dallas facilities (the "WPC press").

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13. Plaintiffs, believing WPC to possess a press of the size and type appropriate for further development of the Lithoflex system, and believing WPC to be a potential customer of the Lithoflex system, contacted WPC through PRI employees Mr. Steve Garner ("Garner") and Mr. John Bird ("Bird") in November of 1994. Bird and Garner showed representatives of WPC the flexographic samples and briefly described DeMoore's Lithoflex system. Following the presentation, WPC expressed interest in acquiring the Lithoflex system technology for use in its own systems.

14. In late 1994 and in 1995, but well prior to August 14, 1995, PRI disclosed to WPC further details of the Lithoflex system and the printer/coater units. In December of 1994, PRI demonstrated components of the Lithoflex system to representatives of WPC, including Davis and Williamson, using PRI's pilot press.

15. PRI's disclosure of the Lithoflex system concept and technology to WPC was made under a confidentiality agreement ("the Confidentiality Agreement") between PRI and WPC, in which, in exchange for the concept and details of the Lithoflex system and the printer/coater units, WPC agreed to maintain the confidentiality of the same.

16. WPC and PRI thereafter entered into an purchase agreement ("the Purchase Agreement") whereby PRI agreed to sell several printer/coater units to WPC and install the same on WPC presses. Under the terms of the agreement, WPC would pay reduced prices for the printer/coater units and installation in exchange for allowing PRI access to WPC's presses for further testing and fine-tuning of the Lithoflex system.

17. Under the terms of the Purchase Agreement, PRI delivered a printer/coater unit to WPC on or about November 15, 1995. The printer/coater unit was installed on the first station of WPC's press for testing. Subsequent stations in the WPC press line included lithographic

printing stations. The first sheets were "Lithoflexed" on the WPC press using the printer/coater unit on December 6, 1995. The testing of the printer/coater unit on the WPC press was a success.

18. On information and belief, WPC continues to utilize DeMoore's Lithoflex system.

19. On August 14, 1995, U.S. Application Serial No. 515,097 ("the '097 application"), for a "Combined Lithographic/Flexographic Printing Apparatus and Process," was filed with the United States Patent & Trademark Office ("PTO"). The '097 application named only Davis and Williamson as inventors, and was subsequently assigned to WPC. Defendants never informed Plaintiffs of any intent by Plaintiffs to file, or that Plaintiffs did file, the '097 application. On information and belief Davis and Williamson are employees of WPC. The application issued to WPC as the '363 patent and describes and claims the Lithoflex system. The '363 patent remains assigned to WPC.

20. On information and belief, Davis and Williamson are not actual inventors of the claimed invention of the '363 patent. The Lithoflex system as invented by DeMoore and explained to WPC by PRI includes all the limitations of the claims of the '363 patent. DeMoore is therefore the sole inventor of the invention claimed in the '363 patent. On information and belief, Defendants knew throughout the prosecution of the '363 patent that DeMoore was the sole actual inventor of the claimed invention of the '363 patent, and intended to fraudulently and wrongfully deprive Plaintiffs of the benefits of DeMoore's invention.

21. The omission of DeMoore from the list of named inventors in the '097 application and the '363 patent was committed without any deceptive intent on the part of DeMoore or PRI.

22. Having successfully tested the Lithoflex system and printer/coater unit on the WPC press, PRI endeavored to market the Lithoflex system to other potential buyers. To that

end, representatives of PRI contacted Hallmark Cards, Inc. ("Hallmark") for the purpose of selling Lithoflex system components to Hallmark.

23. Negotiations between PRI and Hallmark regarding the sale of Lithoflex system components to Hallmark ensued and progressed to a point where agreement appeared eminent. Before entering a purchase order with PRI, however, Hallmark commissioned a patent infringement search to examine the propriety of Hallmark's proposed use of the Lithoflex system.

24. On information and belief, and as a result of this patent infringement search, counsel for Hallmark became aware of the '363 patent, evaluated the proposed use of the Lithoflex system in light of the '363 patent, and concluded that the proposed use would infringe the '363 patent. Upon being informed by counsel of the potential for patent infringement posed by the use of the Lithoflex system, and as a direct result of the existence of the '363 patent, Hallmark concluded that it would not purchase any Lithoflex system components from PRI.

25. In December of 1998, Hallmark informed PRI of the existence of the '363 patent, and that Hallmark would not purchase any Lithoflex system components from PRI. Hallmark further indicated to PRI at this time that Hallmark's purchasing decision was based on the existence of the '363 patent and the potential for infringement of the same.

26. Plaintiffs had no knowledge of the '097 application or of the '363 patent prior to being informed of the patent's existence by Hallmark.

27. Defendants' acquisition and WPC's ownership of the '363 patent directly resulted in the loss of prospective sales to Hallmark, by PRI, of Lithoflex system components and supplies. Defendants' acquisition and WPC's ownership of the '363 patent has further

subsequently resulted in a general inability by Plaintiffs to exploit DeMoore's Lithoflex system, including the prevention of sales of Lithoflex system components and supplies.

28. Upon information and belief, Defendants applied for and secured the issuance of the '363 patent, and WPC secured ownership of the '363 patent, with full knowledge of the nature of the exclusive rights conferred by the '363 patent, namely the exclusive right to make use or sell the claimed invention of the '363 patent.

29. Upon information and belief, Defendants applied for and secured the issuance of the '363 patent, and WPC secured ownership of the '363 patent, with full knowledge that potential users of the claimed invention of the '363 patent, including potential customers of Plaintiffs would become aware of the '363 patent, would likely forego purchases of Lithoflex system components or supplies from Plaintiffs.

30. Thus Defendants applied for and secured the issuance of the '363 patent, and WPC secured ownership of the '363 patent, with full knowledge that their actions would severly limit PRI from making, using, or selling the claimed invention of the '363 patent, and that their actions could thereby cause Plaintiffs to lose prospective sales of Lithoflex system components and supplies.

30. On information and belief, Defendants intended their acquisition and ownership of the '363 patent to prevent Plaintiffs from selling Lithoflex system components and supplies.

COUNT I

CORRECTION OF INVENTORSHIP

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31. Plaintiffs repeat the allegations of Paragraphs 9-30 above.

32. The '097 application and the '363 patent incorrectly omit DeMoore as an inventor of the methods or apparatus claimed therein. The '097 application and the '363 patent further

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incorrectly list Davis and Williamson as inventors of the methods and apparatus claimed therein, despite the fact that neither Davis nor Williamson is a sole or joint inventor of any method or apparatus so claimed. DeMoore is the sole inventor of all methods and apparatus claimed in the '097 application and '363 patent. The omission of DeMoore from the list of inventors designated in the '097 application and the '363 patent arose without any deceptive intent on the part of DeMoore.

33. The PTO, through the Commissioner, is empowered to correct inventorship errors, including misjoinder, where error lists a person who is not an inventor, and nonjoinder, where error fails to list a person who is an inventor. Independently, under Title 35, United States Code, § 256, the federal courts and thus this Court may, on notice and hearing of all parties concerned, determine the inventorship of any patent and make corrections as appropriate. This Court may correct errors of misjoinder without regard to the existence of deceptive intent with respect to the error by either the misjoined person or the actual inventors. This Court may correct errors of nonjoinder only where there was no deceptive intent with respect to the error on the part of the nonjoined actual inventor.

34. Concurrent with the filing of this action, Plaintiffs have notified each person and entity believed to be affected by Plaintiffs" claim that the designation of inventorship of the '363 patent is incorrect. Such persons include the currently designated inventors of the '363 patent, Davis and Williamson, and the assignee of Davis's and Williamson's rights to the '363 patent, WPC. Each such person or entity is in fact a named defendant in this suit and has been provided with a copy of this pleading.

35. Pursuant to Title 35, United States Code, § 256, Plaintiffs request the Court, after an appropriate hearing, to order correction of inventorship of the '363 patent. Plaintiffs

specifically request that the Court remove Davis and Williamson as named inventors for the '363 patent, and add DeMoore as the sole actual inventor for the '363 patent. In the alternative, Plaintiffs specifically request that the Court add DeMoore as a joint inventor for the '363 patent, if the Court determines that DeMoore is a co-inventor of the subject matter claimed in the '363 patent.

COUNT II

PATENT INFRINGEMENT

36. Plaintiffs repeat the allegations of Paragraphs 9 – 30 and 32-35 above.

37. DeMoore is the actual sole inventor of the claimed invention of the '363 patent, and as such is equitable title holder to the '363 patent with standing to sue for infringement of the '363 patent.

38. Davis and Williamson are not actual inventors of the '363 patent and possess no rights under the '363 patent. The assignment of Davis's and Williamson's "rights" under the '363 patent to WPC therefore conveys no actual rights under the '363 patent to WPC. Specifically, WPC possess no right to make, use, or sell the claimed invention of the '363 patent.

39. Upon information and belief, WPC has used and continues to use the claimed methods and apparatus of the '363 patent in its printing operations in this judicial district and elsewhere.

40. Upon information and belief, WPC's use of the claimed methods and apparatus of the '363 patent in its printing operations constitutes infringement in violation of 35 U.S.C. § 271 and Plaintiffs" exclusive rights under the '363 patent.

41. On information and belief, WPC will continue to engage in acts of infringement unless permanently enjoined by this Court.

42. The infringement of the '363 patent by WPC has caused irreparable injury to Plaintiffs and will continue to cause irreparable injury to Plaintiffs unless WPC is permanently enjoined by this Court.

43. The infringement of the '363 patent by WPC has caused and continues to cause damage to Plaintiff, including impairment of the value of the '363 patent and lost sales and profits in an amount yet to be determined.

44. On information and belief, WPC's infringement of the '363 patent in this judicial district and elsewhere has been and continues to be willful.

COUNT III

CONVERSION

45. Plaintiffs repeat the allegations of Paragraphs 9-30, 32-35, and 37-44 above.

46. DeMoore is the actual sole inventor of the methods and apparatus claimed in the '363 patent, and as such, on May 20, 1997, the date of issue of the '363 patent, DeMoore held equitable title to the patent rights associated with that invention.

47. On May 20, 1997, in the City of Dallas, Dallas County, Texas, Defendants unlawfully and without authority assumed dominion and control over DeMoore's property, which is described in Paragraph 46, to the exclusion of DeMoore's rights in this property, in that on that date the '363 patent issued to Defendants. Defendants thus assumed the exclusive right to make, use, or sell the claimed invention of the '363 patent, thereby preventing DeMoore or his licensees from enjoying any benefits of DeMoore's invention.

48. The value of the property at the time and place of the conversion was in excess of $ 450,000, for which sum Plaintiffs sue.

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49. Plaintiffs are entitled to interest on the sum of $ 450,000 from May 20, 1997, at the prejudgment rate of interest.

50. Defendants' conversion of claimed invention of the '363 patent, as alleged above, was fraudulent in that the conversion was accomplished through affirmative misrepresentations of the inventorship of the claimed methods and apparatus, made by Defendants to the PTO during the application for and prosecution of the '363 patent, with full knowledge of the inaccuracy of those statements and to the detriment of DeMoore, the actual inventor of the invention. Accordingly, Plaintiffs ask that exemplary damages be awarded against the Defendants.

COUNT IV

TORTIOUS INTERFERENCE WITH PROSPECTIVE BUSINESS RELATIONS

51. Plaintiffs repeat the allegations of Paragraphs 9-30, 32-35, 37-44, and 46-50 above.

52. Defendants obtained the '363 patent, knowing that DeMoore was in fact the sole actual inventor of the methods and apparatus claimed therein, and knowing and intending that these actions could prevent Plaintiffs from exploiting the claimed invention of the '363 patent through the sale of Lithoflex system components and supplies.

53. In 1998, Plaintiffs and Hallmark agreed in principle, pending the completion of a patent infringement study, to a purchase order in which Plaintiffs would sell Lithoflex system components and supplies to Hallmark.

54. A Hallmark patent infringement study revealed the existence of the '363 patent to Hallmark.

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55. Hallmark subsequently chose not to agree to the purchase order, based upon a fear of potential liability for infringement of the '363 patent.

56. Plaintiffs lost its prospective purchase order with Hallmark as a result of Defendants' acquisition of WPC's ownership of the '363 patent. There is more than a reasonable probability that Plaintiffs would have obtained the purchase order in the absence of Defendants' actions.

57. Defendants' actions in obtaining the '363 patent, as alleged above, were fraudulent in that the acquisition of the '363 patent was accomplished through affirmative misrepresentations of the inventorship of the claimed methods and apparatus, made by Defendants to the PTO during the application for and prosecution of the '363 patent, with full knowledge of the inaccuracy of those statements and to the detriment of DeMoore, the actual inventor of the invention. Accordingly, Plaintiffs ask that exemplary damages be awarded against the Defendants.

58. Defendants' interference with Plaintiffs' prospective business contract with Hallmark has caused damage to Plaintiffs, including specifically by depriving Plaintiffs of profits that they would otherwise have received under the contract. Defendants' interference with Plaintiffs' prospective business contracts continues by preventing additional sales of Lithoflex components and supplies to Hallmark and other third parties.

COUNT V

BREACH OF CONTRACT

59. Plaintiffs repeat the allegations of Paragraphs 9-30, 32-35, 37-44, 46-50, and 51-58 above.

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60. In 1995, and well prior to August 14, 1995, representatives of PRI and WPC agreed that, in exchange for the disclosure by PRI, to WPC, of the details of Plaintiffs' Lithoflex system and printer/coater units, WPC would maintain the confidentiality of those details.

61. PRI subsequently disclosed the details of Plaintiffs' Lithoflex system and printer/coater units, and has fully performed its obligations under the agreement.

62. WPC breached the contract described in Paragraph 60 and breached its position of trust and confidence, when Defendants surreptitiously filed the '097 patent, thus disclosing the details of the Lithoflex system and printer/coater units to the PTO, and ensuring the disclosure of the details to the public at large upon issuance of any patent therefrom. The details were disclosed to the public, in further breach of the agreement, by the issuance of the '363 patent on May 20, 1997.

63. As a result of WPC's breach of contract and breach of trust and confidence, Plaintiffs have suffered damages. In particular, Plaitiffs have suffered consequential damages, in that WPC's disclosure of the details to the PTO and the public has created a prior art reference which serves as an potential barrier against the acquisition of additional patent protection by Plaintiffs, the monetary value of which is to be determined at trial.

COUNT VI

ATTORNEYS' FEES

64. Plaintiffs repeat the allegations of Paragraphs 9-30, 32-35, 37-44, 46-50, 51-58, and 60-63 above.

65. This is an exceptional case within the meaning of 35 U.S.C. § 285. Accordingly, Plaintiffs ask that they be awarded, and that Defendants be made to compensate Plaintiffs for, Plaintiffs' reasonable attorneys' fees.

PRAYER

WHEREFORE, Plaintiffs prays for the entry herein of a final judgment:

(a) correcting the inventorship of the '363 patent, pursuant to 35 U.S.C. § 256, by removing Davis and Williamson as inventors of the invention of the '363 patent and naming DeMoore sole inventor of the claimed invention of the '363 patent or, in the alternative, by naming DeMoore a joint inventor of the claimed invention of the '363 patent;

(b) holding the '363 patent infringed by WPC;

(c) enjoining WPC and its servants, agents, officers and employees and any and all persons acting by or under WPC's authority, or in privity therewith, from engaging in further acts of infringement of the '363 patent;

(d) requiring WPC to account to Plaintiffs for any and all profits derived by WPC, and to compensate Plaintiffs under 35 U.S.C. § 284 for all damages, including lost profits, sustained by Plaintiffs due to WPC's acts of infringement of the '363 patent, together with interest, and that such damages be trebled by reason of the willful and deliberate nature of WPC's infringement;

(e) requiring Defendants to pay the costs of this suit, including, as this is an exceptional case pursuant to 35 U.S.C. § 285, Plaintiffs' reasonable attorneys' fees incurred in bringing and prosecuting its patent claims;

(f) requiring Defendants to compensate Plaintiffs for all damages sustained by Plaintiffs as a result of Defendants' conversion of Plaintiffs' rights to the invention claimed in the '363 patent, including pre- and post-judgment interest and exemplary damages, the amount of which are to be determined at trial;

(g) requiring Defendants to compensate Plaintiffs for all damages sustained by Plaintiffs as a result of Defendants' tortious interference with Plaintiffs' prospective business relations, including pre- and post-judgment interest and exemplary damages, the amount of which are to be determined at trial;

(h) requiring WPC to compensate Plaintiffs for all damages sustained by Plaintiffs as a result of WPC's breach of the Confidentiality Agreement, including pre- and post-judgment interest;

(i) that Plaintiffs be awarded all other such relief as the court may find equitable.

Respectfully submitted:

William D. Harris, Jr.
State Bar #: 09109000
L. Dan Tucker
State Bar #: 20276500
Robert T. Mowrey
State Bar #: 14607500
W. Edward Woodson
State Bar #: 24003207
LOCKE LIDDELL & SAPP LLP
2200 Ross Avenue, Suite 2200
Dallas, Texas 75201-6776

ATTORNEYS FOR PLAINTIFFS

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EXCLUSIVE LICENSE

This Exclusive License is granted effective as of March 11th, 1991, by BIROW, INC., a Connecticut corporation ("Licensor") having its principal place of business at 8 Clover Lane, Westport, Connecticut 06880, to PRINTING RESEARCH, INC., a Texas corporation ("Licensee") having its principal place of business at 10954 Shady Trail, Dallas, Texas 75220.

WHEREAS, Licensor is the owner of record of the following:

1) United States Letters Patent No. 4,796,556, Adjustable Coating and Printing Apparatus by John W. Bird issued June 27, 1989; and

2) United States Letters Patent No. 4,841,903, Coating and Printing Apparatus Including an Interstation Dryer by John W. Bird issued June 27, 1989; and

3) United States Letters Patent No. 4,895,070, Liquid Transfer Assembly Method by John W. Bird issued January 23, 1990; and

4) United States Letters Patent No. 4,939,992, Flexographic Coating and/or Printing Method and Apparatus Including Interstation Driers by John W. Bird issued June 10, 1990; and

5) Application for United States Letters Patent filed in the U.S. Patent and Trademark Office on April 11, 1989, under U.S. Serial No. 07/336435 with respect to Printing Method and Apparatus Including Interstation Drying by John W. Bird;

WHEREAS, Licensee desires to obtain the exclusive right and license to make, use and sell products covered by such Letters Patents and Application for Letters Patent;

NOW, THEREFORE, in consideration of the sum of Ten Dollars ($10.00) and other good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, Licensor hereby

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grants to Licensee the exclusive, irrevocable, worldwide right and license to make, have made, use, manufacture, market, sell, sublicense, lease and otherwise dispose of any and all products, apparatus, devices, equipment, implements, mechanisms, assemblies, methods, techniques, patterns, procedures, routines and systems covered by the aforementioned Letters Patent and Application for Letters Patent.

Licensor represents and warrants that it has not granted and will not grant to others any rights inconsistent with the rights granted herein, and that said Letters Patents and Application for Letters Patent are free and clear of all encumbrances and liens.

IN WITNESS WHEREOF, Licensor has executed this Exclusive License on the date first above written.

LICENSOR:

BIROW, INC.

By: ______________________
Name: John W. Bird
Title: President

By: ______________________
Name: Thomas A. Rowley
Title: Secretary

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REEL 0796 FRAME 0491

RECORDED
PATENT AND TRADEMARK
OFFICE
APR 25 1991

STATE OF TEXAS §
§ ss.
COUNTY OF DALLAS §

On this 12th day of March, in the year of 1991, before me personally appeared JOHN W. BIRD, personally known to me or proved to me on the basis of satisfactory evidence to be the person who executed the written instrument as President of the corporation therein named, and acknowledged to me that the corporation executed it pursuant to its bylaws or a resolution of its board of directors.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my official seal the day and year in this certificate first above written.

Linda Nottingham
Name (Print): LINDA NOTTINGHAM
Notary Public, State of Texas
My commission expires: 4/21/92

LINDA NOTTINGHAM
Notary Public State of Texas
My Commission Expires 4.21.92

0056740492

STATE OF CONNECTICUT §
§ ss. WESTPORT
COUNTY OF FAIRFIELD §

On this 9th day of March, in the year of 1991, before me personally appeared THOMAS A. ROWLEY, personally known to me or proved to me on the basis of satisfactory evidence to be the person who executed the written instrument as Secretary of the corporation therein named, and acknowledged to me that the corporation executed it pursuant to its bylaws or a resolution of its board of directors.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my official seal the day and year in this certificate first above written.

Name (Print):
Notary Public, State of Connecticut
My commission expires:

VIRGINA M. LANGE
Notary Public
My Commission Expires March 31, 1994

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United States Patent [19]

Bird

[11] **Patent Number:** 4,796,556

[45] **Date of Patent:** Jan. 10, 1989

[54] **ADJUSTABLE COATING AND PRINTING APPARATUS**

[75] Inventor: John W. Bird, Westport, Conn.

[73] Assignee: Birow, Inc., Westport, Conn.

[21] Appl. No.: 65,954

[22] Filed: Jun. 24, 1987

[51] Int. Cl.⁴ B05C 11/00

[52] U.S. Cl. 118/46; 118/262; 101/177

[58] Field of Search 118/46, 262, 249; 101/177

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Primary Examiner—Shrive Beck

Assistant Examiner—Alain Bashore

Attorney, Agent, or Firm—Pearman & Green

[57] **ABSTRACT**

An offset lithographic printing machine having a plurality of in-line liquid application stations, at least one of which is an ink image printing station for printing lithographic ink images onto suitable receptive copy sheets, and the final downstream liquid-application station being a coating application station for printing a protective, and/or aesthetic coating over selected portions of, or over the entire ink image-printed surface of the copy sheets. The coating application station comprises a plate cylinder adapted to print liquid coating composition onto predetermined selected areas of the ink image-printed copy sheets by offset-transfer to an intermediate blanket cylinder, a said blanket cylinder adapted to receive said liquid coating composition from the plate cylinder for retransfer onto predetermined selected image-printed areas of the image-printed copy sheets, and also adapted to receive a continuous liquid coating composition for retransfer as a continuous overall coating over the image printed areas of the image printed copy sheets. An adjustable coating-application carriage is supported for movement into coating association with either the plate cylinder blanket cylinder desired, for the application of a printed coating over either preselected limited areas or over the entire image-printed surface of the copy sheets.

23 Claims, 4 Drawing Sheets

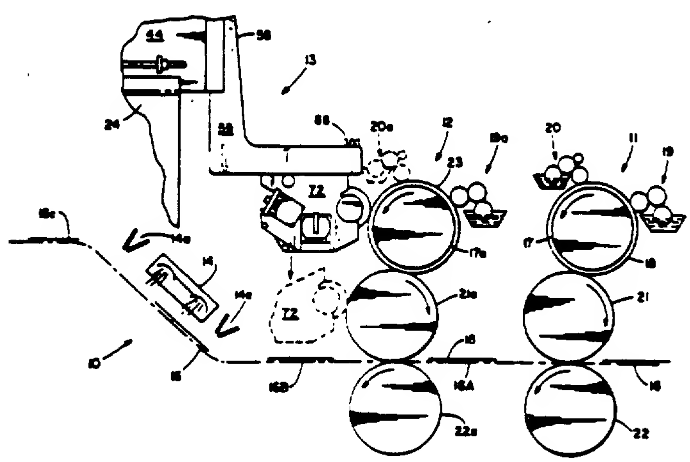

FIG. 1

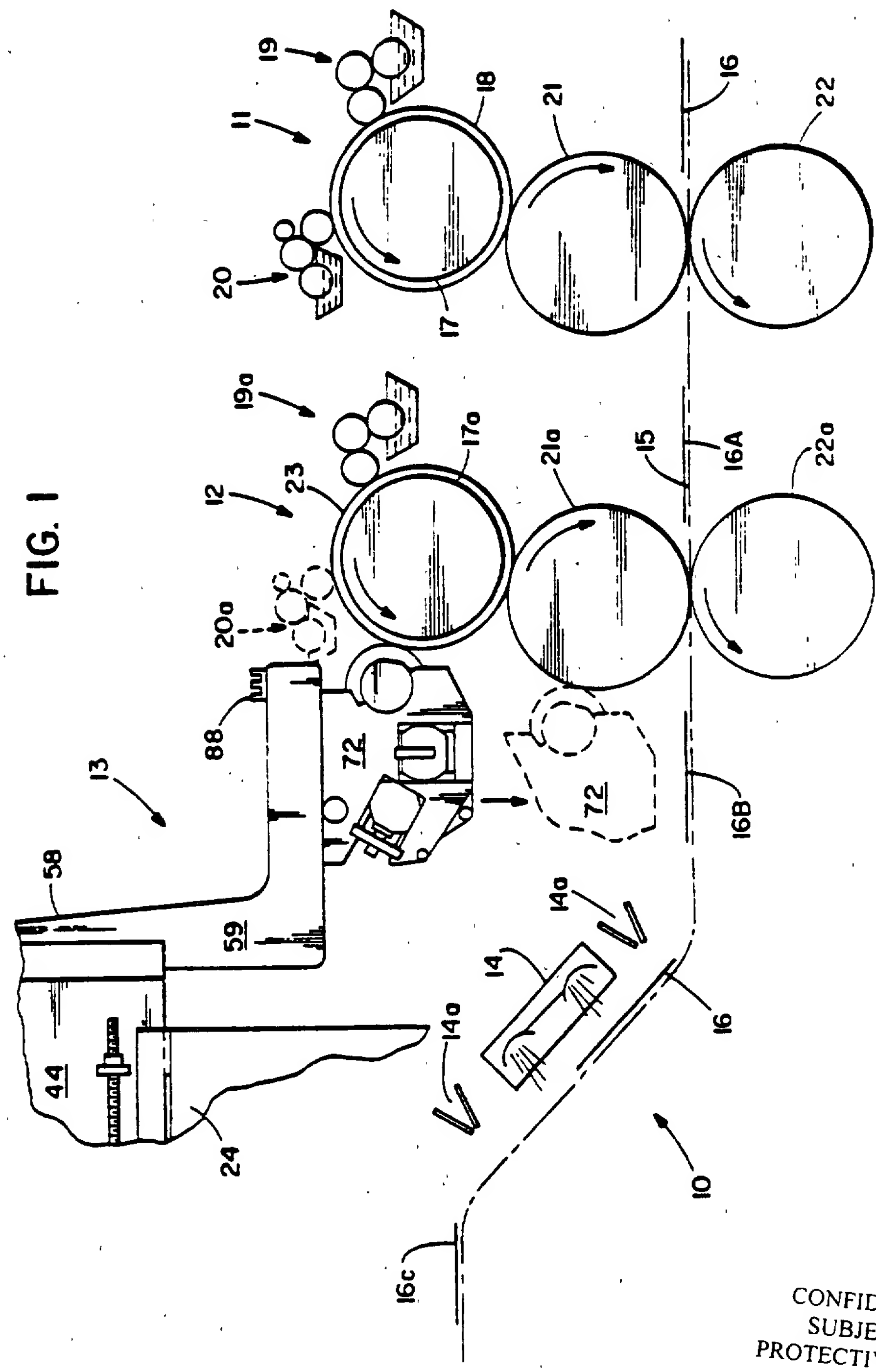
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FIG. 2A

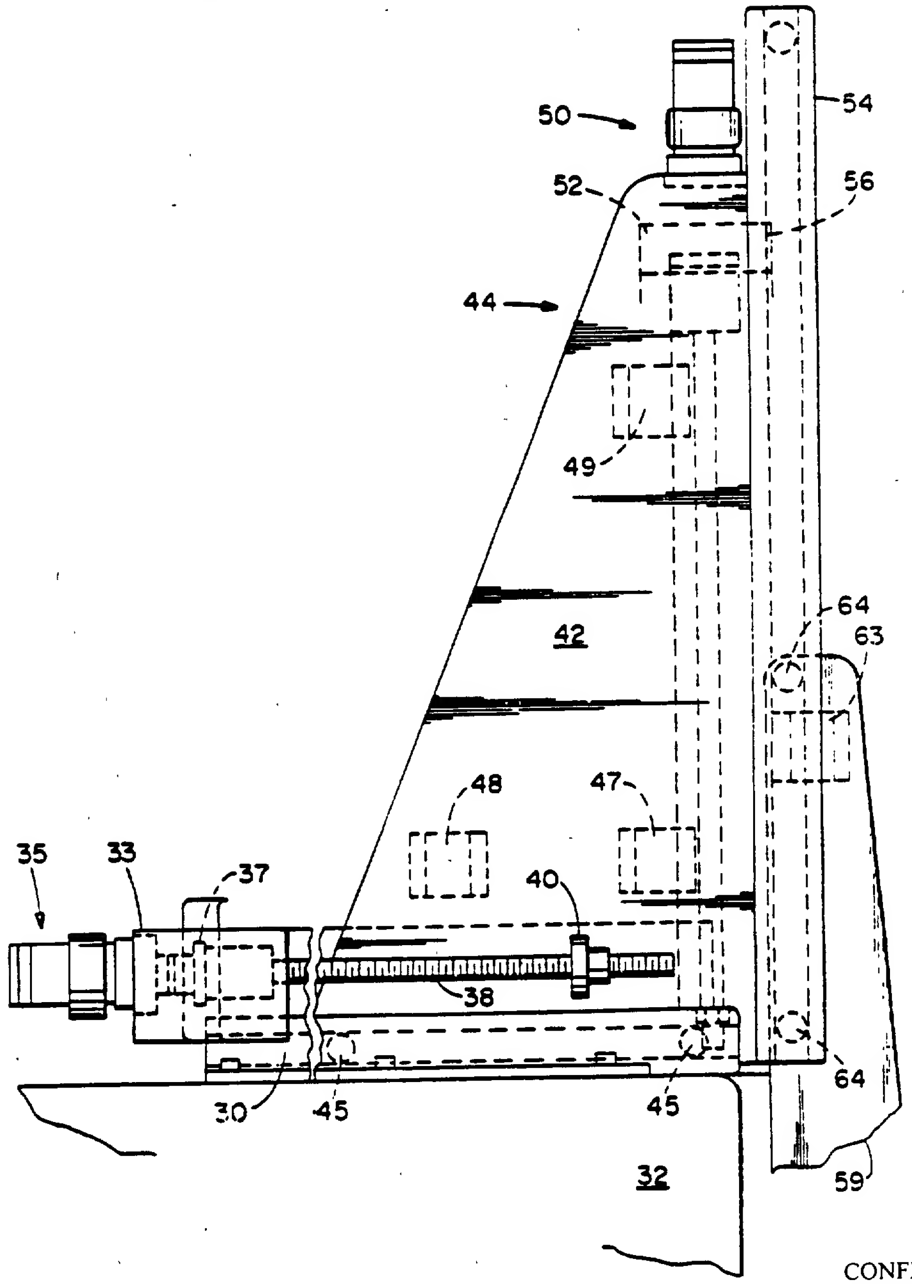

FIG. 2B

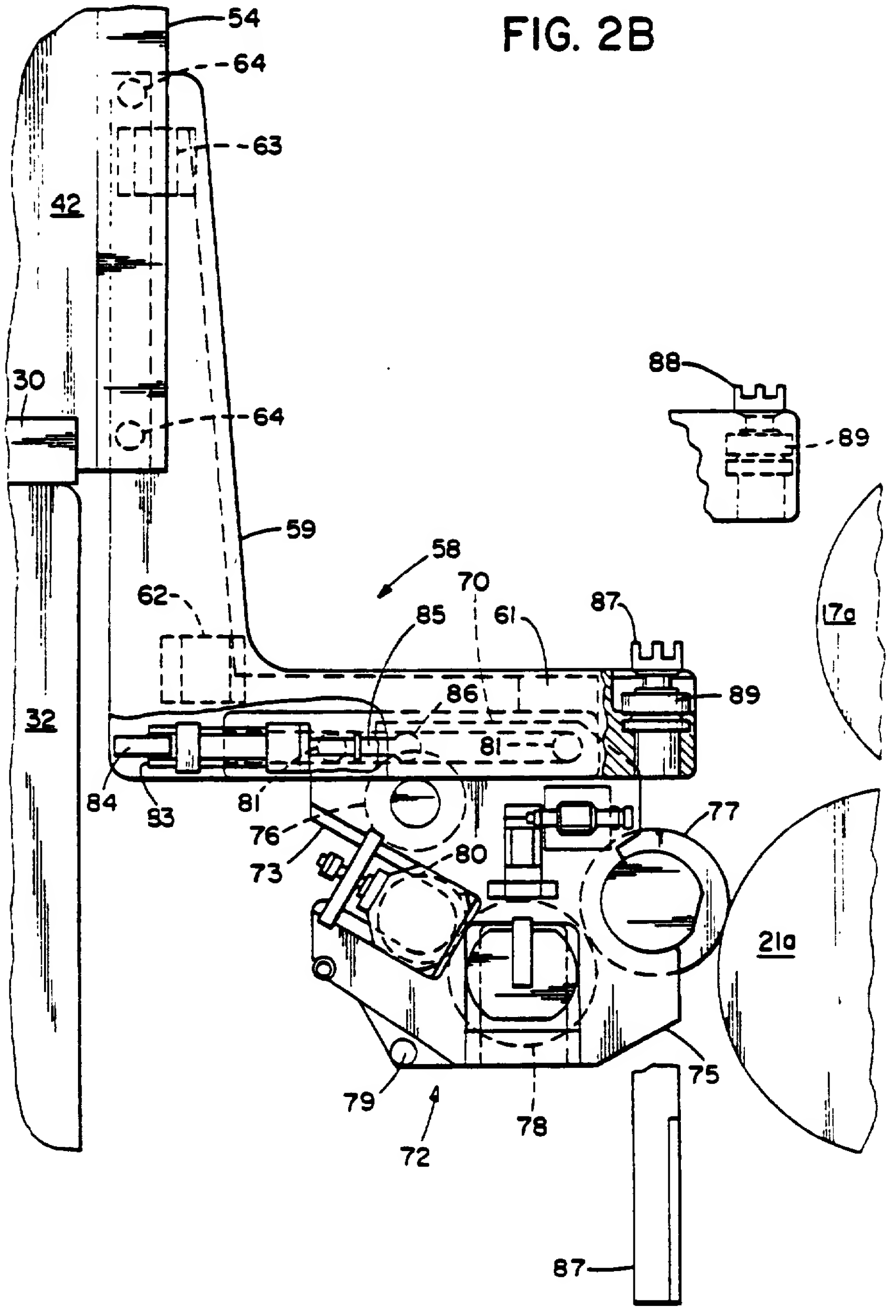
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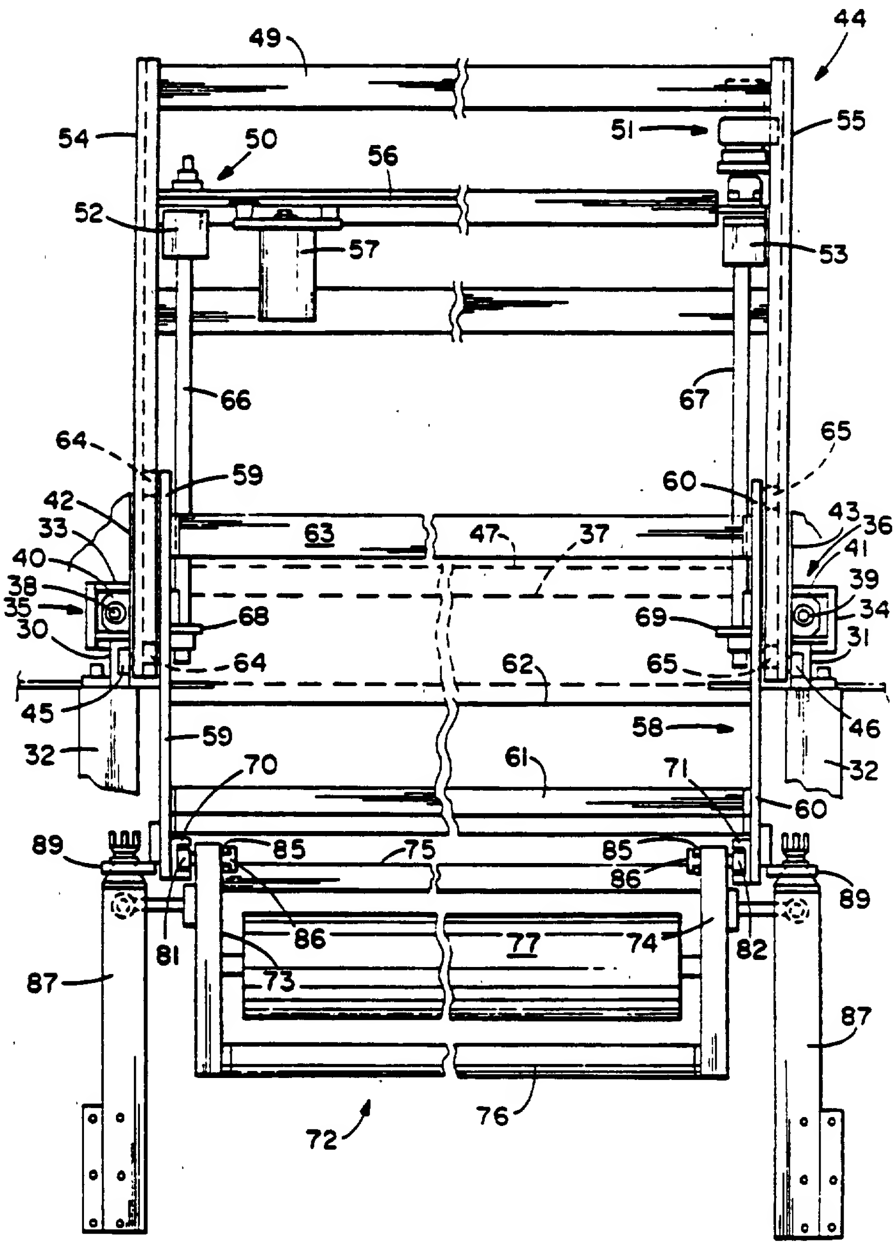
FIG. 3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ADJUSTABLE COATING AND PRINTING APPARATUS

BACKGROUND OF THE INVENTION

Conventional lithographic offset printing machines or presses comprise one or more image printing stations each having a printing roll (sometimes referred to as a plate cylinder) to which is fastened a thin hydrophilic, oleophobic printing plate having image areas which are oleophilic and hyrdoprobic and background areas which are oleophobic and hydrophilic. The plate surface is continuously wetted with aqueous' damping solution which adheres only to the background areas, and inked with oleoresinous ink which adheres only to the image areas of the plate as wet ink. The ink is offset transferred to the rubber surface of a contacting blanket roll (sometimes referred to as a blanket cylinder), and then retransferred to the receptive surface of a copy web or a succession of copy sheets, such as of paper, where the ink air-dries by oxidation and curing after passing through a drying station.

Since image-drying is gradual, it is conventional to spray the printed copies with starch or other "stilting" powder before the copies are stacked. This prevents sticking of the ink images to adjacent copies and also permits the circulation of air for the oxidation curing process.

In cases where cost is not a factor and/or where the aesthetic advantages of a protective supercoating are desired, it is known to provide the printing machine with a downstream coating station having a blanket roll associated with a coating application unit for the application of an overall protective coating over the entire printed area of the copy sheets or web. This also avoids the necessity of powdering the printed images. Reference is made to U.S. Pat. No. 4,270,483 for its disclosure of such an apparatus. The coating unit of U.S. Pat. No. 4,270,483 is pivotally-associated with the blanket roll for movement between coating and noncoating or retracted positions.

It is known to apply pattern coatings of protective composition by means of blanket rolls by cutting into the rubber surface of the blanket to leave raised or relief surface islands which selectively receive the coating composition from the application roll for retransfer to selected areas of the copy sheets in the form of pattern coatings. This procedure has several disadvantages. The make-ready time required for the preparation of such relief blanket rolls is excessive and the procedure requires the tedious, precision efforts of an expert in order to approximate the required registration, whereas precise relief printing plates used on a printing roll can be produced photographically in a short period of time with a minimum of effort and expertise. Moreover, the attachment of a relief printing plate to a plate cylinder provides some degree of adjustability, axially as well as circumferentially, to provide better registration if necessary, whereas no adjustment of the relief portions is possible relative to the blanket roll or cylinder.

Protective coating compositions also improve the appearance of printed documents, particularly high quality, multi-color copies such as posters, record jackets, product brochures, etc., by providing glossy or matte finishes over the entire image-printed surface or over selected image-printed portions thereof such as photographs, product illustrations, etc. Selected area coating, spot coating or perfect registration over predetermined limited printed areas of the copies is advantageous from a cost standpoint since the coating compositions are relatively expensive and the volume required is reduced if the coating is only printed in registration where desired. Also, spot coating is frequently used as a means for highlighting certain portions of the printed copies such as company name or logo, product illustrations, photographs, etc.

While the cost of the protective coating compositions is an important factor, a more important cost factor is the necessity of removing the printed copies from an offset printing press and then running them a second time through a coating machine to print either a full protective coating or a spot protective coating, as desired. This problem is overcome by U.S. Pat. No 4,270,483 with respect to the in-line printing of overall or continuous protective coatings but the problem of providing in-line spot printing of protective coatings with a minimum of make-ready time and a high degree of precision thickness remains.

SUMMARY OF THE INVENTION

An essential objective of the present invention is to provide a printing machine or press for the printing of imaged subject matter onto a receptive substrate, such as a copy web or a succession of copy sheets, said printing machine having a downstream coating station designed for the application of either continuous or spot coatings, as desired, over the image-printed copies in a continuous in-line process.

Another object of the present invention is to provide a coating apparatus designed to be mounted at the final downstream ink-application station of a conventional offset printing machine or press having a plurality of ink-application stations to convert said machine or press, intermittently if desired, to the in-line application of either continuous or spot coatings, as desired.

Yet another object of this invention is the provision of a single coating application apparatus mounted in association with the final downstream liquid application station of a printing press having a plurality of liquid application stations, each having a plate cylinder, a blanket cylinder and an impression cylinder, the coating application apparatus comprising a coating carriage which is adjustable between one coating position in which it coats the plate cylinder and another coating position in which it coats the blanket cylinder of the final downstream station to convert said station to a coating station for the application of either spot or continuous coatings to the surface of the image-printed copies.

The novel apparatus of the present invention comprises a coating application apparatus for an offset printing machine and a printing machine containing such an apparatus, the coating application apparatus having a movable carriage designed for operative association in one position with the plate cylinder and in another position with the blanket cylinder of the final liquid application station of the offset printing machine, the coating carriage being adjustably supported for automatic movement between said two different coating positions. One coating position brings the coating application roll of the carriage into coating association with the plate cylinder for the offset formation of predetermined printed spot coatings onto predetermined image-printed areas of the copy sheets. The other coating position brings the coating application roll of the car-

riage into coating association with the blanket cylinder for the offset formation of a continuous coating onto the entire image-printed surface of the copy sheets. This enables the printing machine to image-print and coat-print the copy web or sheets in a continuous in-line operation, the apparatus being adjustable in simple fashion with a minimum make-ready time to adapt the coat-print step to the application of either spot coatings or continuous coatings depending upon the requirements of the printing operation. This increases the versatility of the offset printing machine, avoids the need for separate printing machines or for separate runs of the printed stock and enables the in-line precise printing of spot coatings in tight register and adjustable thickness, which was not possible with any prior-known offset printing machine.

The novel apparatus of the present invention enables the final downstream liquid application station of the printing machine to be used as either an ink-printing station or as a coating-application station and permits simple and rapid conversion between such utilities.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a vertical cross-sectional view through two downstream liquid application stations of an offset printing machine, illustrating a coating-application unit according to one embodiment of the present invention;

FIGS. 2A and 2B are segmented, detailed side views of coating application unit of FIG. 1 and

FIG. 3 is a horizontal front view of the coating application unit of FIG. 2.

DETAILED DESCRIPTION OF THE INVENTION

Referring to the drawings, FIG. 1 illustrates a downstream portion of an offset printing machine 10 comprising two liquid application stations 11 and 12, the latter including a coating apparatus 13 comprising a coating carriage 58, a radiation drying station 14 including air knives 14a, and a continuous copy sheet gripper system 15 which moves a succession of copy sheets 16 through the printing machine.

The first liquid application station 11 is a conventional offset image printing station comprising a plate cylinder 17, to which is clamped an imaged lithographic printing plate 18 carrying oleophilic image areas, such as words, photographs, etc. on an oleophilic background. The conventional clamping means permits some degree of lateral or axial adjustment and some degree of wrap-around or circumferential adjustment of the plate 18 relative to the plate cylinder 17. Plate cylinder 17 is associated with a dampening system 19 for wetting the entire background surface of plate 18 with aqueous dampening fluid, and with an inking system 20 for inking the imaged areas of the plate 18 with liquid oleoresinous ink.

The inked plate 18 is rotated against the ink receptive surface of a blanket cylinder 21, to which the wet ink images are offset or transferred, and the blanket cylinder 21 is rotated against a copy sheet 16, passed in the nip between the blanket cylinder 21 and an impression cylinder 22, to transfer the wet ink images to the copy sheet 16 and form an image-printed copy sheet 16A which is conveyed to the last liquid application station 12 which includes the coatingapplication apparatus of the present apparatus.

The coating application station 12 can be similar to the inking station 11 with respect to the plate cylinder 17a supporting a printing plate dampening system 19a, blanket cylinder 21a and impression cylinder 22a since in a conventional offset printing machine having a plurality of liquid application stations, all of the stations are generally similar but use different printing plates to image different areas of the same copy sheet with different colored inks. The present apparatus modifies the final downstream inking station to convert it permanently or intermittently to a versatile coating station.

Plate 23 is an offset relief printing plate, preselected areas of which are raised above the background, generally referred to as "relief spots". Such spots are sized and positioned to correspond to areas of the image-printed copy sheets 16a which it is desired to selectively coat.

The essential novelty of the apparatus of FIG. 1 resides in the adjustable coating apparatus 13 which is mounted onto the frame 24 of the printing machine for extension of the coating carriage 58 into the liquid application station 12 for adjustable coating association with either the coating plate cylinder 17a or the coating blanket cylinder 21a, as desired.

The coating application apparatus 13, shown in greater detail in FIGS. 2 and 3, comprises a preferred embodiment of the present invention in that it includes a coating carriage 58 which is horizontally adjustably, in the machine direction, for movement between retracted or passive position and extended or active position, and also vertically adjustable for movement between the levels of the plate cylinder and the blanket cylinder. Moreover, the coating carriage 58 comprises a horizontally adjustable coating applicator unit 72 which is movable in the machine direction between different extended coating positions to accommodate plate and blanket cylinders which are not in vertical alignment, as shown by FIGS. 1 and 2B.

The coating application apparatus 13 of FIGS. 2A and 3 comprises a spaced pair of parallel, horizontal support rails 30 and 31 or legs designed to be bolted to frame portions 32 of the printing machine beyond station 12, rails 30 and 31 each being fastened to a gear housing 33, 34 of a hydraulic horizontal screw drive member 35, 36 connected to each other for simultaneous operation by a drive chain 37. The screw drive members 35 and 36 comprise reversible drive screws 38, 39 which threadably engage nuts 40, 41 which are fixed to the spaced vertical walls 42, 43 of the vertical lift housing 44.

Housing 44 is provided adjacent the bases of walls 42 and 43 with outward projecting cam follower or wheel pairs 45, 46 which are engaged within the horizontal tracks of the rails 30 and 31 to support the vertical lift housing 44 for horizontal movement between extended or active position, illustrated by FIGS. 1 and 2B, and retracted or passive position under the effects of hydraulic activation of the screw drive members 35 and 36. Walls 42 and 43 of housing 44 are fastened together and reinforced by cross-beams 47, 48 and 49.

Vertical or height adjustment of the coating application carriage 58 is made possible by a second pair of associated vertical screw drive members 50 and 51, shown most clearly in FIG. 3, each having a gear housing 52, 53 attached to the upper end of a vertical rail member, 54, 55 of the housing 44, and being connected to each other for simultaneous reversible operation by means of a drive chain 56 through a hydraulic motor 57

Vertical lift housing 44 supports the vertically adjustable carriage 58 which comprises a spaced pair of L-

shaped side wall members 59 and 60 fastened together by cross-beams 61, 62 and 63. The vertical extensions of wall members 59 and 60 are provided with cam follower or wheel pairs 64, 65 which ride within the vertical tracks of rail members 54 and 55 on the inside of housing walls 42, 43 to raise and lower the vertical carriage section 58 under the activation of the screw drive members 50 and 51 since the drive screws 66 and 67 thereof threadably engage nuts 68 and 69, respectively, which are fastened to the lower ends of the vertical extensions of the L-shaped wall members 59 and 60.

The horizontal extensions of the L-shaped wall members 59 and 60 of the carriage 58 comprise lower horizontal track members 70 and 71 which support the coating application unit 72 of the carriage for horizontal adjustment therewithin.

Coating application unit 72 of carriage 58 comprises spaced, parallel side frames 73 and 74 fastened together by cross members 75 and 76 and supporting coating applicator roll 77, pick-up roll 78 positioned to pick up liquid coating composition from the coating pan 79, and adjustable metering roll 80 positioned to control the amount of coating composition passed by the pick-up roll 78 to the applicator roll 77. The outer surfaces of the side frames 73 and 74 are provided adjacent the top edge of each with a spaced pair of cam followers or wheels 81, 82 which ride within the horizontal tracks of the track members 70, 71 of the L-shaped wall members 59 and 60, to support the coating applicator unit 72 for adjustable horizontal movement within the carriage 58.

As shown by FIG. 2, movement of the coating unit 72 is controlled by a pair of hydraulic cylinders 83 each attached by a bracket 84 to an L-shapedwall member 59, 60 in horizontal alignment with the track members 70 and 71, and having their rod end 85 attached to the inside wall of side frames 73, 74 at posts 86. Activation of the hydraulic cylinders causes the coating unit 72 to move horizontally along track members 70 and 71 to position the leading edge of the applicator roll 77 for coating association with either the coating blanket cylinder 21a, as shown in FIG. 2B, or the coating plate cylinder 17a, as shown in FIG. 1. Preferrably the printing machine frame is provided with spaced pairs of latch posts 87 and 88 or support brackets associated with the location of the blanket cylinder 21a and the plate cylinder 17a for engagement within latch brackets 89 attached to the outer surfaces of the horizontal extensions of the L-shaped wall members 59 and 60 in the area of the forward end of the track members 70 and 71. The engagement of the fixed latch post pair 87 within the latch brackets 89 secures the coating applicator carriage 72 in one position for coating the blanket cylinder 21a, as shown in FIGS. 2B and 3, while the engagement of the fixed latch post pair 88, shown by broken lines in FIG. 2B, within the same latch brackets 89 secures the coating applicator carriage 72 in another position, shown in FIG. 1, for coating the plate cylinder 17a. Such engagement requires a presetting of the sequence and duration of operation of the various hydraulic mechanisms. Engagement and disengagement of the latch brackets 89 on posts 87 and 88 requires vertical movement of the carriage 58 within the vertical lift housing 44 by predetermined directional and timed activation of the vertical screw drive members 50 and 51. Vertical alignment of the latch brackets 89 with the latch post pairs 87 and 88 must first be accomplished. This requires horizontal movement of the vertical lift housing 44 supporting the carriage 58 including the coating applicator unit 72, and is accomplished by predetermined directional and timed activation of the horizontal screw drive members 35 and 36, for movement of the vertical lift housing 44 from retracted, non-coating position to extended, aligned position. Movement of the coating applicator unit 72 into coating position requires predetermined directional and timed activation of the horizontal hydraulic cylinders 83. Adjustable stop members may be incorporated to limit the various movements.

As will be clear to those skilled in the offset printing art, the novel printing and coating apparatus of the present invention enables the modification of a conventional offset printing machine having a plurality of liquid application stations to convert it to a printing and coating apparatus which is adjustable in simple manner for the alternative application of either full coatings or spot coatings. Moreover, such modification may be temporary, if desired, so that the final downstream liquid application station may be used for its intended purpose for the application of printed ink images or for its modified purpose for printing overall or spot coatings. The conversion from printing use to spot coating use merely requires retracting or disengaging the ink applicator roll of unit 20a to position shown by broken lines in FIG. 1, replacing the image printing plate on plate cylinder 17a with a relief coating plate 23, cleaning the surface of the blanket cylinder 21a and moving the coating application unit 13 horizontally from retracted position to extended position. If overall or complete coatings are desired it is only necessary to retract or disengage the plate cylinder 17a from coating association with the blanket cylinder 21a, without any alteration of the plate cylinder 17a or its printing plate 23 or ink application unit 20a.

The present coating applicator roll 77 has a substantially smaller diameter than that of the plate cylinder 17a or the blanket cylinder 21a, the diameters of which are equal. The speed of rotation of the applicator roll 77 is adjustable so that its surface speed may be the same as or slower or faster than the surface speed of cylinders 17a and 21a, or in reverse rotation thereto, to provide a brushing action relative thereto, if desired. Such brushing action provides a shearing of the coating composition in the nip therebetween, and a relatively heavy or thick direct deposit of coating composition on cylinders 17a and 21a in cases where the surface speed of roll 77 is faster than that of roll 17a or 21a. This is desirable particularly for the application of spot coatings, since the coating thickness is always split to about one-half as the spot coating is transferred from the relief plate 23 of plate cylinder 17a to the blanket cylinder 21a, and further, split to about one quarter when the spot coating is transferred from the blanket cylinder 21a to the printed copy sheets 16A. The effect of such inherent splitting is reduced by increasing the coating thickness on the relief areas of plate 23.

In cases where the coating composition is applied directly to the blanket cylinder 21a, for the application of continuous coatings to the printed copy sheets 16A, the plate cylinder 17a is retracted from contact with the blanket cylinder 21a so that the only coating split occurs during transfer from the blanket cylinder 21a to the imaged copy sheets 16A.

The offset printing machines to which the present invention applies are conventional machines and therefore the present disclosure does not include details regarding the support structure for the various rolls,

dampening units, inking units, sheet conveyor system, drying station, or copy sheet supplying and stacking stations. In most modern printing machines, the sheet conveyor system is not a gripper belt or chain but rather comprises automatic grippers on a series of contacting impression cylinders and transfer cylinders.

Also, the present coating compositions and systems for providing continuous supplies thereof to the coating applicator unit are conventional in the art.

The terms "vertically" and "horizontally" are used herein and in the appended claims to define general directions of movement, including angular vertical movement from one level to another and/or angular movement in the machine direction. For example, on printing machines where the coating plate cylinder is not in perfect vertical alignment above the blanket cylinder it may be preferable that the vertical rail or track of the vertical lift housing is inclined at an angle similar to the angle from vertical formed by a straight line contacting the surfaces of the plate cylinder and the blanket cylinder to be contacted by the coating applicator roll. Movement of the coating carriage along such an inclined vertical rail is both generally vertical and generally horizontal. Similarly the horizontal track members for the support legs of the apparatus and/or for the coating applicator unit may also be angular to provide some degree of vertical movement in cases where the design of the printing machine frame supporting the present apparatus makes it necessary or advantageous.

It is to be understood that the above described embodiments of the invention are illustrative only and that modifications throughout may occur to those skilled in the art. Accordingly, this invention is not to be regarded as limited to the embodiments disclosed herein, but is to be limited as defined by the appended claims.

What is claimed is:

1. An adjustable in-line coating application apparatus for attachment in association with a dowmnstream liquid application station of an offset printing machine having a plurality of liquid application stations, for converting said downstream liquid application station to a coating application station for applying either continuous or spot coatings over the printed surface of a succession of copy sheets carrying ink images printed thereon at one or more upstream liquid application stations, said downstream liquid application station containing a blanket cylinder positioned to contact said plurality of printed copy sheets and an offset plate cylinder in vertical elevation above said blanket cylinder and supported for adjustment into and out of coating association therewith, said coating application apparatus having vertical guide means, a coating carriage attached to said support for substantially vertical movement along said guide means, said carriage comprising a coating application unit, including a container for a supply of liquid coating composition and an elongate coating applicator roll supported to receive a uniform supply of said composition on the surface thereof and to transfer a uniform supply of said composition to the surface of either a plate cylinder or a blanket cylinder in coating association therewith, and mechanical adjustment means for moving said carriage on said guide means relative to said support vertically between elevations corresponding to the locations of the blanket cylinder and the plate cylinder of an offset printing machine in order to move said coating applicator roll into coating association with either said blanket cylinder or said plate cylinder, as desired.

2. An apparatus according to claim 1 in which the support for said coating application apparatus comprises a spaced pair of parallel elongate horizontal leg members designed to be fastened relative to the frame of an offset printing machine.

3. An apparatus according to claim 2 in which said support comprises a parallel pair of spaced vertical wall members which are fastened to each other to form a vertical guide means on a vertical lift housing for said coating carriage.

4. An apparatus according to claim 3 in which said horizontal leg members comprise horizontal tracks, and said vertical wall members are movably attached to said horizontal tracks to permit horizontal adjustment of the position of said vertical lift housing.

5. An apparatus according to claim 4 in which said coating carriage comprises a parallel pair of vertical side members which are fastened to each other to form said carriage, each said side member being supportingly-engaged by a vertical guide means on a wall member of the vertical lift housing for vertical movement of said carriage relative to said housing.

6. An apparatus according to claim 5 in which each of the vertical side members of the carriage includes a lower, horizontal support extension to which the coating application unit is attached.

7. An apparatus according to claim 6 in which the horizontal support extensions comprise horizontal tracks to which the coating applicator unit is attached to permit horizontal adjustment of the coating applicator unit on the carriage relative to the vertical lift housing.

8. An apparatus according to claim 1 in which said coating carriage comprises releasable latching means for securing the unit relative to the frame of an offset printing machine when the carriage is positioned for movement of the applicator unit into coating association with either the blanket cylinder or the plate cylinder.

9. An apparatus according to claim 5 comprising automatic mechanical means for moving said carriage vertically relative to said vertical lift housing, said means comprising a vertical screw drive assembly one end of which is fastened to a vertical side wall of said housing and the other end of which is fastened to an adjacent vertical side member of said carriage.

10. An apparatus according to claim 4 in which said horizontal adjustment of the position of the vertical lift housing is provided by at least one horizontal screw drive assembly one end of which is fastened to a horizontal leg member and the other end of which is fastened to an adjacent wall member of the vertical lift housing.

11. An assembly according to claim 7 which further comprises means for causing horizontal movement of the coating applicator unit relative to the coating carriage, said means comprising at least one horizontal drive member one end of which is fastened to the applicator unit and the other end of which is fastened to the horizontal support extension of the carriage.

12. An offset printing machine having a frame supporting a plurality of in-line liquid application stations, each station comprising a blanket cylinder positioned to contact a succession of copy sheets to apply liquid thereto, and an offset plate cylinder in printing association with said blanket cylinder to apply liquid to prede-

termined areas thereof for transfer to said blanket cylinder and retransfer to said copy sheets, the final downstream liquid application station comprising a liquid coating station for the application of continuous or spot coatings over areas of the copy sheets which are image-printed with ink in at least one upstream liquid application station which is an ink printing station, said liquid coating station having said plate cylinder and said blanket cylinder in vertical elevation relative to each other and comprising a coating application carriage including a coating applicator unit having a container for liquid coating composition and a coating applicator roll which receives a continuous supply of said liquid coating composition from said container, and vertical guide means for supporting said coating application carriage for mechanically-adjustable vertical movement along said guide means between a first coating elevation position in which said coating applicator roll is in coating association with said blanket cylinder and a second coating elevation position in which said coating applicator roll is in coating association with said plate cylinder, whereby said carriage can be moved mechanically to said first position to cause the application of a continuous liquid coating to the image printed surface of the copy sheets, and can be moved mechanically to said second position to cause the application of spot liquid coatings to predetermined limited areas of the image printed surface of the copy sheets.

13. A machine according to claim 12 in which said carriage is movable out of coating association with said blanket and/or plate cylinders and said final downstream liquid application station is adapted for alternative use as another ink printing station.

14. A machine according to claim 12 in which the means for supporting said coating application carriage includes a spaced pair of horizontal leg members designed to support the coating application carriage in association with final downstream liquid application station.

15. A machine according to claim 12 in which the means for supporting said coating application carriage includes a parallel pair of vertical wall members which are fastened to each other and to said guide means to form a vertical lift housing for said carriage.

16. A machine according to claim 15 in which said vertical wall members are movably attached to horizontal track members to permit horizontal adjustment of the position of said vertical lift housing relative to the blanket and plate cylinders.

17. A machine according to claim 16 in which said coating carriage comprises a parallel pair of vertical side members which are fastened to each other to form said carriage each said side member being supportingly engaged by a vertical guide means on a wall member of the vertical lift housing for vertical movement of said carriage relative to said housing and between at least said first and second coating positions.

18. A machine according to claim 17 in which each of said vertical side members of the carriage includes a lower horizontal support extension to which the coating applicator unit is attached.

19. A machine according to claim 18 in which said horizontal support extensions comprise horizontal tracks to which the coating applicator unit is attached to permit horizontal adjustment of the coating applicator unit relative to the coating carriage and the blanket and plate cylinders.

20. A machine according to claim 12 in which the frame of said machine includes first position latching means associated with the blanket cylinder, and second position latching means associated with the plate cylinder in said coating application station, and said coating carriage includes mating latching means which engage said position latching means when the carriage is moved into said first coating position and into said second coating position.

21. A machine according to claim 17 comprising automatic mechanical means for moving said carriage vertically relative to said vertical lift housing, said means comprising at least one vertical screw drive assembly one end of which is fastened to a vertical side wall of said housing and the other end of which is fastened to an adjacent vertical side member of said carriage.

22. A machine according to claim 16 which comprises automatic means for providing horizontal adjustment of the position of the vertical lift housing comprising at least one horizontal screw drive assembly one end of which is fastened to a horizontal track member and the other end of which is fastened to an adjacent wall member of the vertical lift housing.

23. A machine according to claim 19 which further comprises means for causing horizontal adjustment of the coating applicator unit relative to the coating carriage, said means comprising at least one horizontal drive member one end of which is fastened to the applicator unit and the other end of which is fastened to the horizontal support extension of the coating carriage.

* * * * *

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United States Patent [19]

Bird

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[45] **Date of Patent:** Jun. 27, 1989

[54] **COATING AND PRINTING APPARATUS INCLUDING AN INTERSTATION DRYER**

[75] Inventor: John W. Bird, Westport, Conn.

[73] Assignee: Birow, Inc., Westport, Conn.

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[52] U.S. Cl. 118/46; 101/201; 101/217; 118/66; 118/258; 118/262; 118/264; 118/602; 427/258; 427/382; 427/411

[58] Field of Search 118/46, 66, 602, 258, 118/264, 262; 101/201, 217; 427/382, 258, 411

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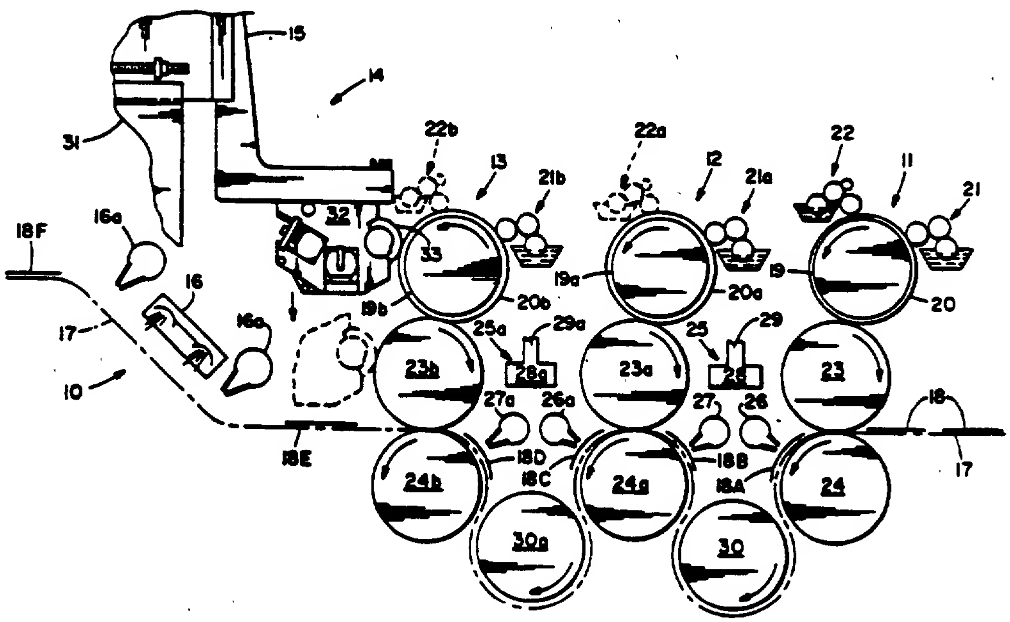
Attorney, Agent, or Firm—Perman & Green

[57] **ABSTRACT**

An offset lithographic printing method and machine having a plurality of in-line liquid application stations, at least one of which is an ink image-printing station for printing lithographic ink images on a suitable receptive copy sheet, and at least the final downstream liquid-application station is a coating application station for printing a protective, and/or aesthetic coating over selected portions of, or over the entire ink image-printed surface of the copy sheet. The present method and apparatus involves the placement of a drying station between liquid application stations to evaporate volatile solvent or vehicle from the ink images and/or to solidify the liquid coating applied at upstream stations before the application of a continuous or spot coating thereover at the next downstream coating station.

5 Claims, 1 Drawing Sheet



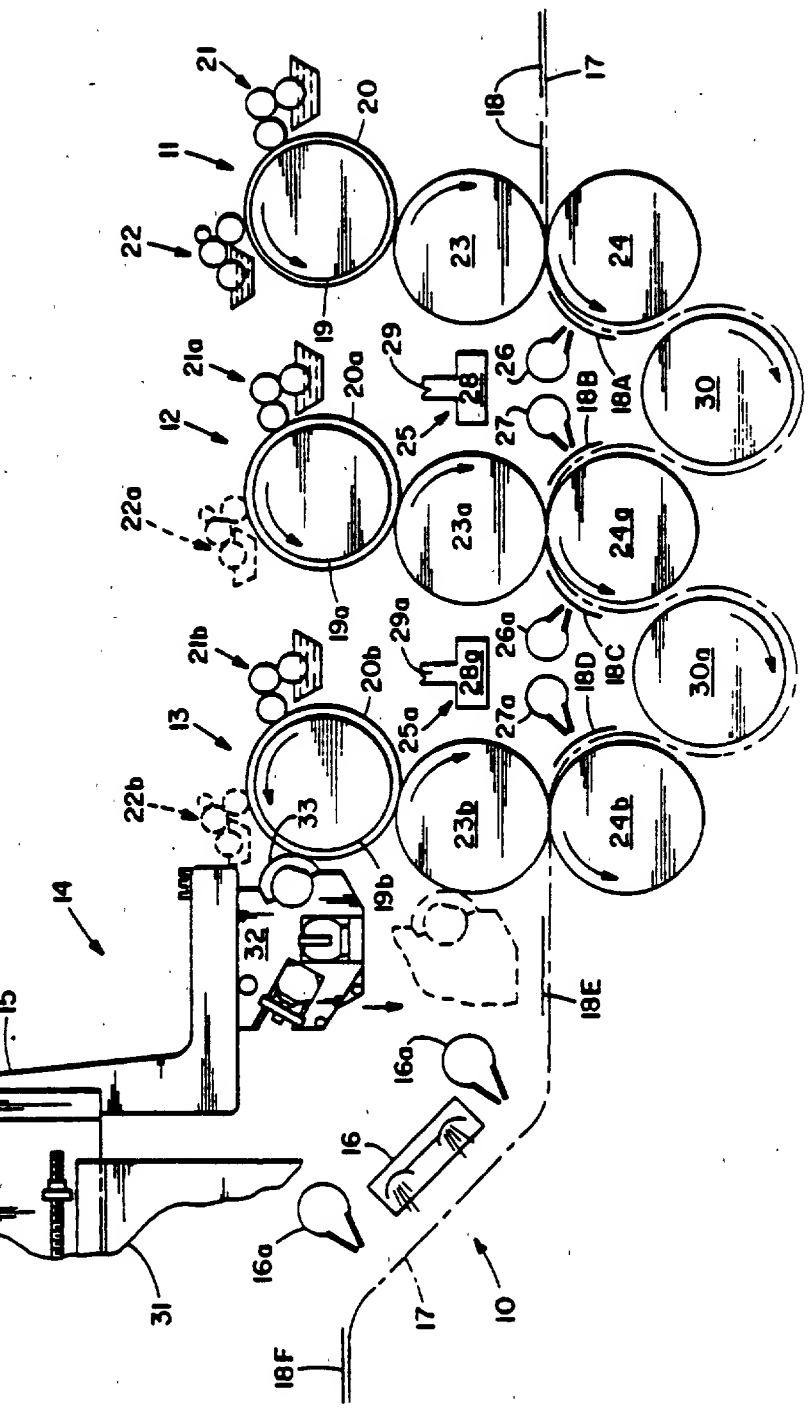


FIG. 1

COATING AND PRINTING APPARATUS INCLUDING AN INTERSTATION DRYER

BACKGROUND OF THE INVENTION

Conventional lithographic offset printing machines or presses comprise one or more image-printing stations each having a plate cylinder to which is fastened a thin hydrophilic, oleophobic printing plate having image areas which are oleophilic and hydroprobic and background areas which are oleophobic and hydrophilic. The plate surface is continuously wetted with aqueous damping solution, which adheres only to the background areas, and is then inked with oleoresinous ink composition which adheres only to the image areas of the plate as wet ink. The ink is offset-transferred to the rubber surface of a contacting blanket cylinder, and then retransferred to the receptive surface of a copy web or a succession of copy sheets, such as of paper, where the ink gradually hardens or cures by oxidation after passing through a final drying station located downstream of the final liquid application station where the volatile solvent is evaporated from the ink composition of the images.

Since image-curing is gradual, it is conventional to spray the printed copies with starch or other "stilting" powder before the copies are stacked. This prevents sticking of the uncured ink images to adjacent copies and also permits the circulation of air for the oxidation-curing process.

In cases where cost is not a factor and/or where the aesthetic advantages of a protective supercoating are desired, it is known to provide the printing machine with a downstream coating station having a blanket cylinder associated with a coating application unit for the application of an overall protective coating over the entire printed area of the copy sheets or web.

This also avoids the necessity of powdering the printed images. Reference is made to U.S. Pat. No. 4,270,483 for its disclosure of such an apparatus. The coating unit of U.S. Pat. No. 4,270,483 is pivotally-associated with the blanket cylinder for movement between coating and non-coating or retracted positions. Reference is also made to my copending U.S. patent application, Serial No. 65,954, filed on even date herewith.

Protective coating compositions also improve the appearance of printed documents, particularly high quality, multi-color copies such as posters, product brochures, etc., by providing glossy or matte finishes over the entire image-printed surface or over selected image-printed portions thereof such as photographs, product illustrations, etc. Selected area coating, spot coating or perfect registration over predetermined limited printed areas of the copies is advantageous from a cost standpoint since the coating compositions are relatively expensive and the volume required is reduced if the coating is only printed in registration where desired. Also, spot coating is frequently used as a means for highlighting certain portions of the printed copies such as company name or logo, product illustrations, photographs, etc.

While the in-line application of a protective or aesthetic coating over the offset-printed images on a succession of copy sheets will prevent the dried but uncured printed images from sticking to adjacent copy sheets, the relatively wet condition of the printing ink composition and its solvent and/or diluent content, at the time that the coating composition is applied thereover, and the presence of water from the dampening system in the copy sheets, produces a visible change in the appearance of the portions of the coating overlying the printed images during the evaporation of the solvent, diluent, water, etc., whereby, for example, a glossy-surfaced protective coating acquires a flat, matte or non-glossy surface, particularly in areas overlying the dried and cured printed images, and even the affected areas are not uniform in appearance depending upon the colors and/or surface areas of the underlying printed images. For example, printed colored photographs, half-tone illustrations, and the like, which are intended to be emphasized or heightened in appearance, such as by the application of glossy spot coatings thereover, undergo loss or degradation in the uniformity of their appearance and their color during the drying of the copy sheets.

Also, in cases where the protective or aesthetic coating is only spot-applied, such as over printed photographs, product illustrations, etc., the images printed on other surface areas of the copy sheets remain exposed and can stick to adjacent copy sheets unless stilting powder is applied, as discussed herein before.

The speed of operation of conventional offset printing and coating machines makes it impossible to apply successive continuous and spot coatings to a succession of copy sheets because the second coating will not adhere properly to the first coating while the latter is still wet, and/or the second coating will undergo degradation or loss of gloss during drying of the underlying coating.

These defects are of substantial importance in cases where the additional expense of one or more coatings is justified by the desired results, i.e., promotional posters, artwork, product containers, record jackets, videocassette boxes, etc. The defects, i.e., uneven surface appearance of the coating(s), detract from the appearance of the underlying images or photographs, particularly in the case of multi-colored images or photographs and are due to the presence of residual volatile solvents, diluents, water, etc., within the oleoresinous inks of the images or photographs, and the presence of water in the copy sheets, at the time that the first coating is applied thereover, and/or to the presence of volatile solvents, diluents or water within the first coating or undercoating at the time that the second coating is applied thereover. The application of a top coating over the printed images and/or over a first coating retards the volatile solvent, diluent or water against escape in the final drying station, but it eventually migrates into the top coating during the final drying and gradual curing of the ink images over a period of several hours time, resulting in a loss of perfection in the surface finish of the top coating.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a novel printing and coating method and apparatus for the in-line application of one or more protective or aesthetic coatings over imaged subject matter offset-printed onto each of a succession of copy sheets while avoiding the usual degradation or loss of uniformity of the surface appearance of areas of the coating(s) applied over the printed images and/or over underlying coated areas.

It is another objective of the present invention to enable the in-line application of a second protective or aesthetic coating, such as a glossy-finish spot coating, over a first protective coating, such as a continuous matte-finish coating, while avoiding the problems of poor adhesion and degradation or loss of glossy surface appearance of the second coating.

Essentially, the present invention is concerned with providing unblemished coated lithographic copies of the types desired in cases where the additional expense of supercoatings is justified by the desired results.

The present method and apparatus provides for the in-line drying of lithographic ink images, including photographic multi-color reproductions, and/or the drying of first continuous or spot coatings, printed or applied at one liquid application station before the application of a continuous or spot coating over said ink images or over said continuous spot coating at the next downstream liquid application station by interposing an in-line drying station between said one and next liquid application stations in order to more completely dry the ink images or first coating prior to the application of a final coating thereover, whereby the eventual drying of said final coating results in a substantially perfect surface finish.

The oleoresinous inks conventionally used to print lithographic copies generally comprise a mixture of oxidizable drying oils, such as safflower oil or linseed oil, a compatible resin binder material, such as a phenolic resin or a varnish, pigment such as carbon black, drying agents, and a volatile solvent such as mineral spirits, or other solvent for the resin and oil. The printed copy sheets also contain some water from the dampening system. Drying of the images occurs in two stages, namely evaporation of the volatile solvent in the first stage to form the relatively dry, tacky printed images, and oxidation-curing of the oleoresinous printed composition which requires several hours time and results in the final non-sticky, smear-resistant printed images. The present invention is concerned with first-stage drying or solvent/water evaporation prior to the application of a supercoating over the printed images.

The coating compositions conventionally-used to apply protective or aesthetic coatings over printed lithographic images are aqueous solutions, dispersions or emulsions of water-dispersible or water-soluble film-forming binder materials, such as acrylic resins, hydrophilic colloids, vinyl alcohol, etc. Also, coating compositions free of volatile solvents or vehicles are commonly used, such as resin precursor compositions which are polymerizable or curable by exposure to ultraviolet or other radiation. Such compositions are based upon liquid acrylic monomers or pre-polymers, or photopolymers and photoinitiators, cross-linking agents and/or other conventional ingredients. Both solvent-applied and solvent-free coating compositions can produce microporous coatings which are permeable to oxygen to hasten the curing of the oleoresinous inks. While they are also permeable to the volatile ink solvents, diluents and water, the escape of these volatiles mars the appearance of the surface finish of the coatings, as discussed supra.

The second problem, pertinent to the embodiment of drying between coating stations, relates to the reduced receptivity of wet undercoatings for supercoatings applied thereover, producing uneven, discontinuous or spotty supercoatings having "holidays" or areas which have not accepted the supercoating.

The novel method and apparatus of the present invention overcomes these problems by drying the ink-imaged and/or undercoated copy sheets prior to the application of the undercoating over the ink-printed images and/or prior to the application of the supercoating over the undercoating, whereby substantially-perfect coatings having excellent surface properties, such as gloss, are produced.

DESCRIPTION OF THE DRAWING

FIG. 1 is a vertical cross-sectional view, through the final three liquid application stations of an offset printing machine, illustrating the interposition of in-line drying stations between the last two liquid application stations and a final downstream liquid application station which is a coating-application station.

DETAILED DESCRIPTION OF THE DRAWING

Referring to the drawing, FIG. 1 illustrates a downstream portion of an offset printing machine 10 comprising three liquid application stations 11, 12 and 13, a coating apparatus 14 according to aforementioned co-pending application Serial No. 65,954 filed June 24, 1987, comprising a coating carriage 15, a final radiation drying station 16 including air knives 16a, and a continuous copy sheet conveyor means 17 which moves a succession of copy sheets 18 through the printing machine.

The first liquid application station 11 is a conventional offset image printing station comprising a plate cylinder 19, to which is clamped an imaged lithographic printing plate 20 carrying oleophilic image areas, such as words, photographs, etc. on an oleophobic, hydrophilic background. The conventional clamping means permits some degree of lateral or axial adjustment and some degree of wrap-around or circumferential adjustment of the plate 20 relative to the plate cylinder 19. Plate cylinder 19 is associated with a dampening system 21 for wetting the entire hydrophilic background surface of plate 20 with aqueous dampening fluid, and with an inking system 22 for selectively inking the image areas of the plate 20 with liquid oleoresinous ink composition containing a volatile organic solvent.

The inked plate 20 is rotated against the ink-receptive surface of a blanket cylinder 23, to which the wet ink images are offset or transferred, and the blanket cylinder 23 is rotated against a copy sheet 18, passed in the nip between the blanket cylinder 23 and an impression cylinder 24, to transfer the wet ink images to the copy sheet 18 and form an image-printed copy sheet 18A. Some water from the dampening system is also transferred to the surface of the copy sheet 18A. Sheet 18A is conveyed, imaged face up, through a 25 first drying interstation 25, comprising a pair of spaced, elongate air knives 26 and 27 and a vapor-extraction unit 28 containing an intake fan and a outlet conduit 29 which conveys the volatile vehicle vapors to a recovery unit, to the atmosphere or for 30 other safe disposal.

As illustrated, the printed copy sheets 18A, are conveyed by grippers past the first air knife 26, under transfer cylinder 30 and past the second air knife 27, to form dried printed copy sheets 18B which move into the next liquid application station 12.

The air knives 26 and 27 and the extraction unit 28 are conventional elements normally used as final drying elements on printing and coating machines of different types. Knives 26 and 27 are elongate tubular elements provided with an elongate narrow slot formed by op-

posed, converging walls. Heated air is circulated through the tubular elements under pressure and is expelled from the elongate slot as a concentrated narrow band of high speed hot air which is directed against the ink-printed copy sheets 18A to evaporate the volatile solvent and water therefrom to release solvent and water vapor which is withdrawn by the extraction unit 28. Substantial drying is produced by the first air knife 26, and the second air knife 27 preferrably is included, as illustrated, to insure complete drying prior to the entry of the copy sheets 18B to the next liquid application station.

In the apparatus of FIG. 1, the second liquid application station 12 can be either another ink printing station, such as for printing ink of a second color, or it can be a first coating station Thus the various elements of station 12 are numbered similarly to those of station 11 but including the suffix a.

Where station 12 is another ink printing station, the first drying interstation 25, upstream therefrom, functions only as a supplemental drying station and can be excluded or disconnected.

Where station 12 is a first coating application station, the first drying interstation 25 is a critical component of the present invention. In such case, the inking system 22*a* of station 12 is withdrawn, as shown by means of broken lines, and the dampening system 21*a* is converted to a dampener coater system by providing a continuous supply of the desired coating composition to the supply pan thereof, i.e., an aqueous dispersion of a film-forming binder material containing in the case of matte-finish coatings, a diffusion filler such as silica or the like.

Generally, where the station 12 is a first coating station, the top roll 19*a* will be a plate cylinder having a full plate 20*a* for the application of continuous coatings to the intermediate blanket cylinder 23*a* or transfer cylinder and then to the dried ink-printed copy sheets 18B to form continuous coated printed copy sheets 18c. However, if desired, plate cylinder 19*a* may have a spot-receptive plate or relief plate 20*a* for the transfer of spot coatings to the intermediate blanket cylinder 23*a* and then to predetermined areas of the printed copy sheets 18B to form spot-coated printed copy sheets 18C.

Most commonly, the first coating will be a complete or continuous coating of a composition providing a matte non-glossy finish or a utility (semi-gloss) finish, and the second coating will be a spot coating of a composition providing a glossy finish to highlight predetermined areas of the printed, coated copies.

The coated printed copy sheets 18C exiting the first coating station 12 are conveyed by grippers, coated side up, through the second drying interstation 25*a*which is similar to the first drying station 25 and comprises a similar pair of spaced elongate air knives 26*a* and 27*a* and a similar extraction unit 28*a* and exhaust outlet conduit 29*a*.

The line of forced hot air from the first knife 26*a*, across the width of the copy sheets, substantially dries the first coating by evaporating the water vehicle therefrom, after which the dried, coated copy sheets 19D are conveyed by transfer roll 30*a* to the second air knife 27*a* to insure complete drying of the first coating prior to the entry of the coated printed copy sheets 18D into the final coating station 13 which includes the coating-application apparatus of the copending application, in the illustrated embodiment, but which may be a conventional coating station.

In cases where the first and/or second coating composition is free of volatiles and solidifies by polymerization curing, the drying interstation 25*a* and/or downstream drying station 16 will contain a suitable radiation source such as ultraviolet lamps.

The coating application station 13 also can be similar to the inking station 11 and first coating station 12 with respect to the plate cylinder 19*b* supporting a printing plate dampening system 21*b*, inking system 22*b*, blanket cylinder 23*b* and impression cylinder 24*b* since, in a conventional offset printing machine having a plurality of liquid application stations, all of the stations are generally similar but use different printing plates to image different areas of the same copy sheet with different colored inks. The present apparatus, requiring at least one coating-application station, and modifies at least the final downstream inking station to convert it permanently or intermittently to a coating-application station as shown by FIG. 1 or, alternatively, as illustrated by U.S. Pat. No. 4,270,483 discussed hereinbefore.

Plate 20*b* is an offset relief printing plate, preselected areas of which are raised above the background, generally referred to as "relief spots" Such spots are sized and positioned to correspond to areas of the image-printed copy sheets 18D which it is desired to selectively coat.

The adjustable coating apparatus 14 is mounted onto the frame 31 of the printing machine for extension of the coating carriage 15 into the liquid application station 13 for adjustable coating association with either the coating plate cylinder 19*b* or the coating blanket cylinder 23*b*, as desired.

The preferred coating application apparatus 14 includes a coating carriage 15 which is horizontally adjustably, in the machine direction, for movement between retracted or passive position and extended or active position, and also vertically adjustable for movement between the levels of the plate cylinder and the blanket cylinder as shown by means of broken lines. Moreover, the coating carriage 15 comprises a horizontally-adjustable coating applicator unit 32 which is movable in the machine direction between different extended coating positions to move the coating applicator roll 33 into coating association with printing and blanket cylinders which are not in vertical alignment, as disclosed in detail in my aforementioned copending application.

Thus, the coating carriage 15 and the applicator unit 32 are adjusted in the final coating station 13 to associate applicator roll 33 with either the spot relief plate 20*b* on printing roll 19*b*, for the printing of spot coatings, or with the blanket roll 23*b*, for the application of continuous coatings onto the dried, coated, printed copy sheets 18D, to form double-coated printed copies 18E. Copies 18E are transported by grippers past a final downstream radiant dryer 16 and air knives 16*a*, to evaporate the water vehicle from the second coating and form final copies 18F which are stacked to permit final curing of the oleoresinous printing ink.

The essential novelty of the present invention resides in the interposition of a drying station, such as 25 and 25*a*, between an ink printing station and a coating station, and preferably also between coating stations on machines having a plurality of coating stations, in order to substantially completely evaporate the volatile solvent or vehicle from the printed ink images, and evaporate any residual dampening water from the printed copy sheets, before the application of a spot or continuous coating thereover, and preferably to substantially

completely solidify and dry the first coating such as by irradiating to polymerize or by evaporating the volatile solvent, vehicle and/or water from the coated, printed copy sheets before the in-line application of a second spot or continuous coating over the first-applied coating, as illustrated.

In operation, a succession of copy sheets 18 is automatically gripped by the conveyor means 17 and transported through one or more ink printing stations 11 into printing contact with one or more ink blanket rolls 23 to print images, such as of different colors, on predetermined areas of each copy sheet, using conventional oleoresinous inks containing volatile organic solvent(s). At each ink-printing station 11, an offset printing plate 20 is fastened to a plate cylinder 19, moistened with water/chemical dampening fluid by means of dampening unit 21 and inked by means of inking unit 22. The ink is selectively received by the image areas of the plate 20, where some water dampening solution is picked up by the ink, transferred to the surface of the blanket cylinder 23 and re-transferred to the upper surface of a copy sheet 18 passed in the nip of cylinder 23 and impression cylinder 24. At this point, the ink images on each imaged copy sheet 18A still contain the volatile organic solvent and some water dampening solution which migrates into the copy paper.

Rather than moving the inked copy sheets 18A directly from a printing station 11 to a coating station 12, as is conventional in the art, the present method and apparatus provides for intermediate or interstation drying of the inked copies to evaporate the volatile organic solvent and water dampening solution from the ink images and copy paper to form solvent-free copies 18B prior to the application of a protective and/or aesthetic coating thereover.

In the embodiment of FIG. 1 the ink-printed copies 18A are moved through an interstation drying station 25 by directing the path of the copy sheets down under a transfer cylinder 30 and up over the coating impression cylinder 24a of the coating station 12. The drying of the copy sheets is accomplished by one or more high velocity hot air knife drying elements, such as 26 and 27 shown in FIG. 1, which heat the ink image, sufficiently lowering the solvent vapor pressure while the high velocity air scrubs the vapor from the surface to evaporate substantially all of the volatile organic solvent and water and form substantially solvent-free copies 18B before the copies 18B pass in the coating nip at coating station 12.

The evaporated solvent and moisture is drawn into the solvent extraction unit 28 by an exhaust fan 31 and removed from the ambient atmosphere by conduit 29 for safety purposes.

On machines having a single coating application station, such as station 12 or station 13 of FIG. 1, the solvent-free copies 18B are moved through said coating station 12 or 13 to receive either a continuous or a spot coating to form coated, printed copy sheets 18C which are transported to the final downstream drying station 16, 16a. On machines having two coating stations 12 and 13 used for the application to two superposed coatings, either of which may be spot or continuous, matte or glossy, the dried, printed copy sheets 18B are moved through the first coating station 12 to form coated, printed copy sheets 18C which are moved through the second interstation drying station 25a to form dried coated copy sheets 18D. Sheets 18D are moved through the second coating station 13 and on through the downstream drying station 16, 16a.

After curing for several hours, the coated, printed copies 18F are found to be free of the surface defects of copy sheets printed and coated in similar manner but in the absence of interstation drying.

While the present specification and drawing refer to a continuous copy sheet conveyor means 17 carrying automatic grippers, it will be clear to those skilled in the art that most printing and coating machines convey the copy sheets by means of automatic grippers present on each of a series of contacting cylinders, such as the impression cylinders 24, 24a and 24b and the interposed transfer cylinders 30 and 30a of FIG. 1.

It is to be understood that the above described embodiments of the invention are illustrative only and that modifications throughout may occur to those skilled in the art. Accordingly, this invention is not to be regarded as limited to the embodiments disclosed herein, but is to be limited as defined by the appended claims.

What is claimed is:

1. In a continuous in-line offset lithographic printing machine for printing and coating a continuous succession of receptive copy paper sheets, comprising a plurality of liquid application stations, each comprising a plate cylinder for supporting a lithographic printing plate and including means for supplying oleous printing composition to oleophilic image areas on the water-coated surface of a said printing plate supported thereon, a blanket cylinder for receiving said printing composition and water from said plate cylinder and for transferring said printing composition and water to a succession of individual receptive copy paper sheets, and an impression cylinder forming a nip with said blanket cylinder through which said individual receptive copy paper sheets are passed to receive printing composition and water from said blanket cylinder, at least one said liquid application station being an upstream ink printing station for the transfer of printing composition in the form of ink images containing a volatile vehicle onto said succession of copy sheets, and at least one said liquid application station being a downstream coating station for the application of a printing composition in the form of a continuous or spot coating of liquid composition over the ink-imaged surface of said copy sheets, means for feeding said succession of individual receptive copy paper sheets through the nips of said blanket and impression cylinders of said liquid application stations, and a final downstream drying station for drying or otherwise solidifying said coated copy paper sheets, the improvements which comprises an intermediate in-line drying station positioned after each of said liquid application stations, each said drying station comprising means for directing forced hot air against the ink printed copy paper sheets to effect the evaporation of water and the volatile vehicle from the ink images printed on said copy paper sheets prior to the entry of the ink-imaged copy paper sheets into the next liquid application station including into said coating station.

2. A printing machine according to claim 1 having two adjacent downstream coating stations, characterized by the presence of another intermediate in-line drying station positioned in-line therebetween to effect the solidification of the coating applied at the first coating station prior to the entry of the coated copy sheets into the second coating station.

3. A printing machine according to claim 1 in which said coating station comprises a coating application assembly which is adjustably supported for coating association with either the plate cylinder, for the application of spot coatings, or the blanket cylinder, for the application of continuous coatings, to said copy sheets.

4. A printing machine according to claim 1 in which said intermediate drying station also comprises a vapor extraction means.

5. A printing machine according to claim 1 in which said means comprises an air knife.

* * * * *

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United States Patent [19]
Bird

[11] **Patent Number:** 4,939,992

[45] **Date of Patent:** * Jul. 10, 1990

[54] **FLEXOGRAPHIC COATING AND/OR PRINTING METHOD AND APPARATUS INCLUDING INTERSTATION DRIERS**

[75] Inventor: John W. Bird, Westport, Conn.

[73] Assignee: Birow, Inc., Westport, Conn.

[*] Notice: The portion of the term of this patent subsequent to Jun. 27, 2006 has been disclaimed.

[21] Appl. No.: 336,219

[22] Filed: Apr. 11, 1989

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 65,914, Jun. 24, 1987, Pat. No. 4,841,903.

[51] Int. Cl.[5] B41F 5/24

[52] U.S. Cl. 101/183; 101/424.1; 101/488; 101/211; 118/46

[58] Field of Search .... 101/115, 488, 424.1, 101/183, 138, 136, 177, 181; 118/46, 66, 58; 427/378, 379, 382; 34/1 SS

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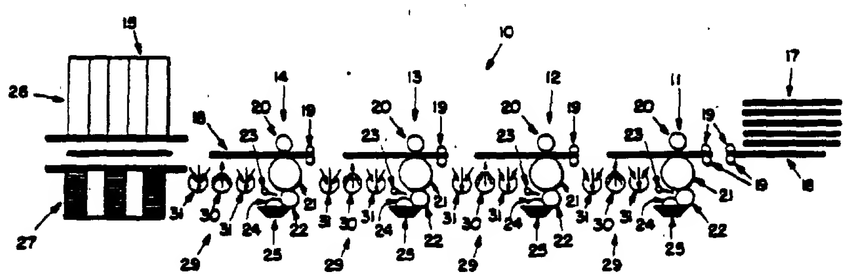
Primary Examiner—Clifford D. Crowder
Attorney, Agent, or Firm—Perman & Green

[57] **ABSTRACT**

A straight line flexographic printing method and machine having a plurality of in-line liquid application stations, at least one of which is an upstream ink image-printing stations for printing ink images on a succession of cardboard copy sheets, and at least one of which is a final downstream liquid-application station which may be a coating application station for printing a protective, and/or aesthetic coating over selected portions of, or over the entire ink image-printed surface of each cardboard copy sheet. The present method and apparatus involves the placement of a forced hot air drying station between each of the liquid application stations to evaporate volatile solvent/diluent from the ink images applied at each inking or coating station before the application of additional ink images or coatings thereover at the next downstream liquid application station.

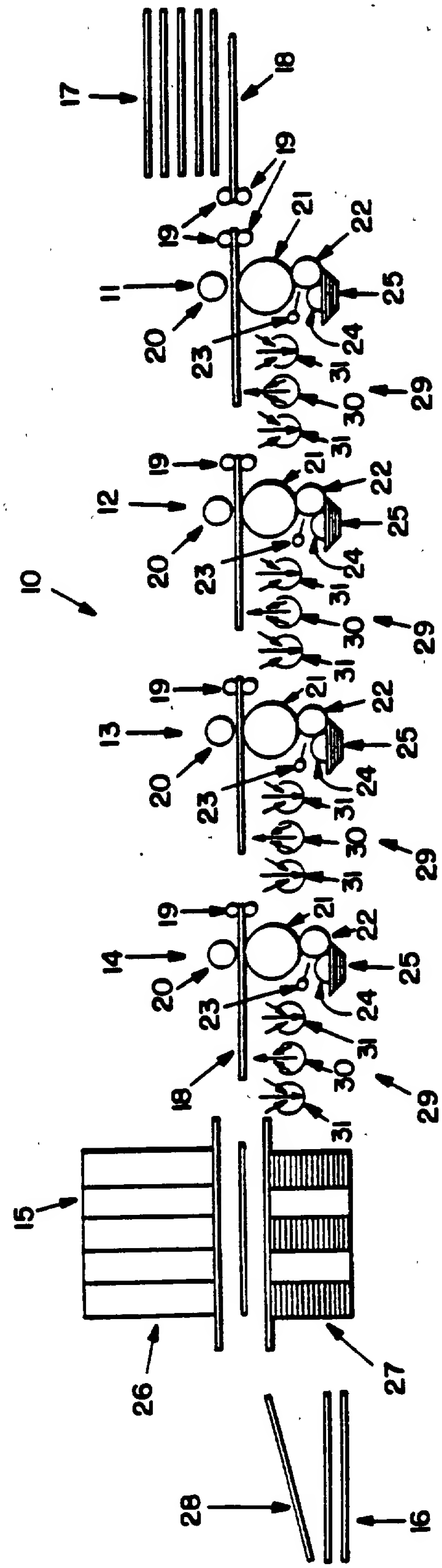
11 Claims, 1 Drawing Sheet



CONFIDENTIAL
SUBJECT TO
PROTECTIVE ORDER

W001012

FIG. 1.



FLEXOGRAPHIC COATING AND/OR PRINTING METHOD AND APPARATUS INCLUDING INTERSTATION DRIERS

BACKGROUND OF THE INVENTION

The present application is a continuation-in-part of application Ser. No. 65,914 filed June 24, 1987, now U.S. Pat. No. 4,841,903.

Conventional flexographic coating and/or printing machines or presses comprise one or more image-printing stations each having a plate cylinder to which is fastened a flexographic plate having raised image or printing areas. Aqueous or solvent ink is applied to the raised image areas, which ink is transferred directly to an absorbent copy sheet or web.

This differs from lithographic printing in which the flat, imaged surface of a plate is continuously wetted with aqueous damping solution, which adheres only to the background areas, and the plate is then inked with oleoresinous ink composition which adheres only to the image areas of the plate as wet ink. The ink is offset-transferred to the rubber surface of a contacting blanket cylinder, and retransferred to the receptive surface of a copy web or a succession of copy sheets, such as of paper, where the ink gradually hardens or cures by oxidation, in some cases after passing through a final drying station located downstream of the final liquid application station where the volatile solvent is evaporated from the ink composition of the images.

In multicolor printing processes and machines of both flexographic and lithographic types, the copy web or sheets pass through a plurality of ink-printing stations in which inks of different colors are printed over the same areas in partial or complete registration to produce multi-ink images or image portions having a variety of desired colors or color-blends. However such multi-ink images vary in sharpness, color-intensity and tone or hue depending upon the number of underlying ink portions.

Stiff, heavyweight cardboard sheets, such as corrugated cardboard, can only be printed and/or coated on a straight line flexographic printer and/or coater since such sheets cannot be caused to wrap around and over plate cylinders or impression cylinders, as is common with lithographic presses and with some known flexographic presses which are used for printing flexible sheets.

Flexographic straight-line printing machines are employed for the printing of relatively thick sheets of highly absorbent material, such as corrugated cardboard, which are moved in a straight line, in flat condition, through one or more ink-printing stations. At each such station the thick absorbent sheets pass in the nip between a flexographic plate cylinder and an impression or back-up cylinder, the raised images on the plate applying flexographic ink directly to the absorbent surface of each sheet, such as cardboard. The flexographic ink comprises resin, pigment and volatile diluents and/or solvent and dries by the absorption of the diluent/solvent into the absorbent surface. This results in some spreading of the printed images, lines, etc., with resultant loss of sharpness, detail and quality of print. This is particularly true where different colored inks are printed in partial or complete registration, which further causes variations in coloration or color tone between areas which are overprinted and areas which are not, e.g., the redness of a red line printed over a grey

underprint is visibly different from the redness of the same line extending onto unprinted areas of the sheet, due to variations in the ability of the sheet to quickly absorb the diluent/solvent. The same is true with respect to the lack of uniformity of surface appearance of a solvent-applied overcoating.

In cases where cost is not a factor and/or where the aesthetic advantages of a protective supercoating, generally referred to as a coating in the flexographic industry, are desired, it is known to provide the printing machine with a downstream coating station having a coating application unit for the application of an overall protective coating over the entire printed area of the copy sheets.

While the in-line application of a protective or aesthetic coating over the flexographic images on a succession of copy sheets will improve the appearance of the print and render it smear-resistant and weather-resistant, the relatively wet condition of the printing ink composition, particularly in overprinted areas, at the time that the coating composition is applied thereover, produces a visible change in the appearance of the portions of the coating overlying the printed images during the evaporation and/or absorption of the solvent, diluent, water, etc., whereby, for example, a glossy-surfaced protective coating acquires a non-uniform flat, matte, or non-glossy surface, particularly in areas overlying the multi-printed images, and even the affected areas are not uniform in appearance depending upon the colors and/or surface areas of the underlying printed images due to the solvent/diluent in the coating interacting with the still-wet color inks. For example, printed colored images, half-tone illustrations, and the like, which are intended to be emphasized or heightened in appearance, by the application of glossy coatings thereover, undergo loss or degradation in the uniformity of their appearance and their color during the drying of the coating.

These defects in color quality and coating appearance are of substantial importance in cases where the additional expense of one or more coatings is justified by the desired results, i.e., promotional displays, artwork, product containers, etc. The defects, i.e., uneven surface appearance of the coating(s) and the quality of the underlying color images, detract from the appearance of the coating and/or underlying images, particularly in the case of multi-colored images and are due to the presence of various amounts of residual volatile solvents, diluents, water, etc., within the flexographic inks of the first images at the time that the second flexographic images are applied thereover, and/or to the presence of volatile solvents, diluents or water within the second subsequent flexographic ink images at the time that the coating is applied thereover. The application of a top coating over the printed images retards the volatile solvent, diluent or water against escape in the final drying station, but the volatiles can eventually migrate from the cardboard into the top coating during the final drying of the printed cardboard, resulting in a loss of perfection in the surface finish of the top coating.

These problems have not been important in cases where the sheets being printed are cardboard shipping cartons or the like, where high quality is not considered important. However in some cases, such as with display cardboard and ultimate sale cardboard containers, such as shoe boxes, toy boxes, clothing closets, etc., where high quality, multi-color printing is important, it has

been necessary to print an outer paper sheet by means of higher quality printing processes and then adhere or laminate the printed sheet to the cardboard support. This is expensive and labor-intensive. The present invention makes this unnecessary for many flexographic applications.

It is known to provide one or more drying stations between inking stations on continuous web flexographic printing machines. However such machines convey the copy sheet through a tortuous path and thus are only useful for printing flexible webs and not sheet lengths or cardboard blanks.

It is an object of the present invention to provide a novel flexographic printing and/or coating method and apparatus for the in-line application of one or more inks and/or protective or aesthetic coatings over imaged subject matter flexographically printed onto each of a succession of heavyweight, absorbent copy sheets while avoiding the usual degradation of sharpness, detail, color uniformity or loss of uniformity of the surface appearance of areas of the ink(s) and/or coating applied over the previously ink-printed images.

It is another objective of the present invention to provide a flexographic printing method and apparatus for providing high quality flexographic printing directly on heavyweight sheets, such as corrugated cardboard, thereby avoiding the need for pre-printing paper, such as by offset lithographic means, and thereafter adhering it to a cardboard support.

Essentially, the present invention is concerned with providing high quality flexographic copies of the types desired, directly on heavyweight absorbent sheets particularly in cases where the additional expense of multiple colors and supercoatings is justified by the desired results.

SUMMARY OF THE INVENTION

The present flexographic method and apparatus provides for the inline forced hot air drying of flexographic ink images, including multicolor images and photographic reproductions, printed or applied at one liquid application station before the application of a second printing ink or a continuous or spot coating over said ink images at the next downstream liquid application station by interposing an in-line drying station between each of said liquid application stations in order to predry the first colored ink images prior to the application of images of a second color or a final coating thereover, whereby the drying of each ink removes volatile solvents/diluents which can cause the ink images to spread or broaden, and/or blemish the next ink or coating applied thereover.

The evaporation of volatile solvents/diluents from flexographic ink images applied to stiff, absorbent sheets is unknown and unobvious since such images are intended to dry by absorption of the volatile solvents/diluents and oil of the ink into the absorbent paper sheet, such as the outer paper ply of a corrugated cardboard. However I have discovered that the interstation evaporation of such volatiles dries the ink images before they can spread, bleed or wick into the absorbent paper support, thus preserving their sharpness, detail and coloration. Moreover such evaporation dries the surfaces of the first printed images so that they are more receptive to second images or coatings applied thereover and more resistant to being diluted, spread and/or broadened by the volatiles present in the second applied images or coating. Moreover the pre-removal of the volatile avoids the accumulation of volatiles, in different quantities, in different areas of the printed copy sheets or cardboard sheets, depending upon the number of overprints, the presence of which can continue to cause the images to spread or broaden and/or can result in color degradation and degradation in the uniformity of the appearance of an overcoating, if present.

The present invention is concerned with drying or solvent/diluent evaporation prior to the application of a second ink or a supercoating over the printed images.

The coating compositions conventionally used to apply protective or aesthetic coatings over printed images are aqueous solutions, dispersions or emulsions of water-dispersible or water-soluble film-forming binder materials, such as acrylic resins, hydrophilic colloids, vinyl alcohol, etc. Also, coating compositions free of volatile solvents or vehicles are commonly used, such as resin precursor compositions which are polymerizable or curable by exposure to ultraviolet or other radiation. Such compositions are based upon liquid acrylic monomers or pre-polymers, or photopolymers and photoinitiators, cross-linking agents and/or other conventional ingredients. Both solvent-applied and solvent-free coating compositions can produce microporous coatings which are permeable to volatiles. While they are permeable to volatile ink solvents, diluents and water, the escape of these volatiles mars the appearance of the surface finish of the coatings, as discussed supra.

Multicolor flexographic printed ink images commonly are formed by using inks containing pigments of different primary colors which, when combined in superposition, produce different secondary colors depending upon the identity and number of primary colors used. However, unless each ink image is dried sufficiently to evaporate the solvents and water present therein, before a second ink is printed in partial or full registration thereover, said solvents and water produce blemishes in the total image when they are eventually evaporated. Such blemishes include voids uneven tones, ragged edges, etc.

Another problem, pertinent to the embodiment of drying between printing stations, relates to the reduced receptivity of wet images for images and/or supercoatings applied thereover, producing uneven, discontinuous or spotty images or supercoatings having "holidays" or areas which have not accepted the images or supercoating.

The novel flexographic method and apparatus of the present invention overcomes these problems with stiff, heavyweight absorbent sheets by drying the ink-imaged copy sheets prior to the application of additional ink images and/or prior to the application of a coating over the ink-printed images, whereby substantially-perfect flexographic images and/or coatings having excellent uniformity, color tone and surface properties, such as gloss, are produced on stiff copy sheets, such as cardboard, printed and/or coated in a straight line flexographic apparatus.

THE DRAWING

FIG. 1 is a vertical cross-sectional view of a flexographic printing and punching machine, illustrating four liquid application stations and the interposition of inline drying stations between each of the liquid application stations and including a final downstream in-line drying station in advance of an optional die cutting, folding and/or gluing creasing station.

DETAILED DESCRIPTION

Referring to the drawing, FIG. 1 illustrates a flexographic printing machine 10 comprising four liquid application stations 11, 12, 13 and 14 the final downstream station 14 being a coating station, if desired, an an optional die cutting, creasing, folding and/or gluing station 15 at which the printed cardboard copies are die cut into desired shapes, such as carton blanks, and creased for folding purposes, if desired, prior to stacking at 16.

As illustrated, the present apparatus includes a feeding station 17 for feeding a continuous supply of cardboard blanks or sheets 18 in a straight line between a plurality of feed rolls 19 into and through each of the liquid application stations 11 to 14 in which each sheet 18 is engaged between an upper impression cylinder 20 and a lower printing cylinder 21. The printed blanks 18 are finally fed to a cutting and creasing press station 15 in which they are die cut and creased, and moved to a stack 16.

Each of the flexographic printing stations 11 to 14 comprises a flexographic plate cylinder 21, the final downstream one of which, in station 14, can be one for printing an overall or spot coating over the portions of the sheet 18 printed with ink images in stations 11, 12 and 13. The liquid application systems in stations 11 to 14 each comprise the plate cylinder 21, a metering roll 22 with associated doctor blade 23, an application roll 24 and an ink (or coating) supply 25. The illustrated ink (or coating) supply 25 is a pan into which the roll 24 extends to receive a continuous supply of the ink or coating composition as it is rotated in the counter-clockwise direction. However most commercially available flexographic printing machines pump the ink or coating supply as a continuous supply onto the surface of the applicator roll 24. The doctor blade 23 is adjustable relative to the surface of the metering roll 22 in order to control the thickness of the ink or coating layer moved onto the plate surface on the plate cylinder 21 for transfer to the undersurface of each cardboard sheet 18.

The apparatus includes conventional registration means, including feed rolls 19, so that each sheet 18 and the plate on each printing cylinder 21 are in exact registration to precisely control the areas of each sheet 18 to be printed with different colored inks at stations 11 to 14 or to be printed with coating composition at station 14.

The multi-printed sheets 18 are moved into the optional station 15, which includes a movable cutter/-crease die 26 and an anvil 27, in order to cut away and/or crease predetermined portions thereof to form printed blanks 28 which are stacked at 16.

The essential novelty of the present flexographic printing apparatus resides in the plurality of interstation driers 29, one or more of which are located after each of the printing stations 11 to 14 for purposes of rapidly drying the ink images applied to sheets 18 at each printing station 11 to 13 before the printed sheets enter the next printing station and to dry the final ink or coating after print station 14. This has been found to result in substantially sharper, clearer images being produced on the cardboard sheets as compared to conventional straight line flexographic printers which permit the images to dry by absorption of the volatile ink solvent-/diluent into the cardboard surface. Moreover the present apparatus has been found to permit the overprinting of different colored inks in partial or complete registration without dilution or spreading or alteration of the sharpness or color tone of the underlying images. The pre-drying of the underlying images sets their color and sharpness, preventing them from being spread and diluted by absorption by the cardboard sheet. Moreover the pre-drying of the images renders them more resistant to being redissolved and spread or diluted by the volatile solvent/diluent of the next-applied ink, and provides a pre-dried ink surface which is more receptive to being overprinted with the next-applied ink and is resistant to being drawn back off the cardboard surface by the pressure of the next ink printing cylinder 21.

Referring to FIG. 1, each interstation drier 29 comprises at least one elongate tubular forced hot air knife 30 which is closely-spaced from the printed undersurface of the sheets 18, and an associated pair of elongate tubular vapor suction means 31 for withdrawing the evaporated ink vehicle or solvent to a recovery unit or for safe release to the outside atmosphere.

In operation, the inked plate on the first flexographic cylinder 21 is rotated against the ink-receptive surface of each cardboard sheet 18, to which the wet flexographic ink images are transferred to form an image-printed copy sheet 18. Each sheet 18 is conveyed, imaged face down, through a first drying interstation 29, comprising at least one forced hot air knife 30 and a spaced pair of vapor-extraction units 31 which withdraw and convey the volatile vehicle vapors to a recovery unit, to the atmosphere or for other safe disposal.

As illustrated, each printed copy sheet 18 is conveyed past the first air knife 30 to form a dried printed copy sheet which is moved into the next liquid application station 12.

The air knife 30 and the extraction units 31 are conventional elements normally used as final drying elements on printing and coating machines of different types, and are sufficiently small in diameter, i.e., about two inches, that they can be accommodated within the small areas present between printing stations on conventional straight-line flexographic printing machines. Knives 30 are elongate tubular elements provided with an elongate narrow slot formed by opposed, converging walls. Heated air is circulated through the tubular elements under pressure and is expelled from the elongate slot as a concentrated narrow band of high speed hot air which is directed against the undersurface of the ink-printed copy sheets 18 to evaporate the volatile solvent or vehicle therefrom to release vapor which is withdrawn through elongate slots in the extraction units 31. Substantial drying is produced by the each air knife 30, but a spaced second air knife may be included at each drying station 29 to insure complete drying prior to the entry of the copy sheets 18 to the next liquid application station.

In the apparatus of FIG. 1, the second ink application station 12 is another ink printing station, such as for printing ink of a second color. Thus the various elements of station 12 are numbered similarly to those of station 11.

The printed copy sheets 18 exiting the second printing station 12 are moved by feed rollers 19, printed side down, through the second drying interstation 29 which is similar to the first drying station and comprises a similar elongate air knife 30 and a similar spaced pair of extraction units 31.

The line of forced hot air from the second knife 30, across the width of the copy sheets printed in station 12, substantially dries the second-applied ink images by evaporating the vehicle therefrom, after which the

dried, copy sheets 18 are conveyed by downstream feed rollers 19 for entry of the twice printed copy sheets 18 into the next printing station 13 where ink images of a third color are printed over the pre-applied, pre-dried ink images, and are dried at the next downstream inter-station drier 29 prior to entry into the final printing station 14. The final downstream station 14 can, if desired, be a coating application station which is similar to the inking stations 11 to 13 with respect to flexographic plate cylinder 20 and its associated rollers, except that the plate has an overall or spot coating surface, and coating composition rather than ink is fed thereto from supply 25.

Thus, the station 14 can be a coating station for the application of continuous spot coatings onto the pre-dried printed copy sheets 18 which are transported by feed rollers 19 past a final downstream drying station 29 and its air knife 30 to evaporate the water or other volatile solvent/diluent from the coating and form final copies 18 which are cut, creased, folded and/or glued and stacked.

In operation, a succession of cardboard copy sheets 18 is automatically moved in a straight line by feed roller 19 and transported through two or more ink printing stations into printing contact with two or more flexographic cylinders 21 to print images, such as of different colors, on predetermined similar and/or different areas of the underside of each copy sheet, using conventional aqueous flexographic inks containing volatile organic solvents(s) and water At each ink-printing station 11 to 14 a flexographic printing plate is fastened to a plate cylinder 21 and inked by means of metering roller 22. The ink is selectively received by the image areas of the plate and transferred to the under-surface of a copy sheet 18 passed in the nip of cylinder 21 and impression cylinder 20. At this point, the ink images on each imaged copy sheet 18 still contain the volatile organic solvent and water. Rather than moving the inked copy sheets 18 directly from the first ink printing station to the next ink printing station 12, as is conventional in the art, the present method and apparatus provides for intermediate or interstation drying of the inked copies to evaporate the volatile organic solvent from the ink images and copy sheet to form solvent-free copies 18 prior to the application of new ink images thereover.

Flexographic processes are conventionally used to print ink images onto absorbent paperboard, drying of the ink images being caused by the absorption of the volatile ink vehicle into the copy sheet. Heretofore it has not been possible to apply high quality multicolor ink images onto cardboard in a single pass on straight line flexographic machines because the volatile solvent-/diluent of the after-applied ink images redissolves and smears the first applied images which mask the absorbent copy sheet against rapid absorption of the after-applied solvent. The same problem occurs when solvent/diluent-applied coating compositions are applied over ink images in the flexographic process.

The present invention solves these problems by providing the interstation forced hot air driers between each of the liquid application stations on a straight line flexographic printing and/or coating apparatus, whereby the volatile solvents and water are evaporated to dry the ink images rapidly before additional images or coatings are printed thereover. Rapid evaporation drying renders the dry ink images resistant to being dissolved or smeared, and reduces the dwell time of the after applied solvents. Conventional drying by absorption is very slow, does not remove the solvents, diluents or water from the copy sheets and retards drying in cases where the later applied composition is applied over pre-printed areas of the absorbent copy sheet.

Thus the present flexographic printing process makes it possible to print stiff cardboard copy sheets, even those which have little or no porosity and little or no absorbing ability, such as cardboard having a printing face of high quality non-absorbant paper or plastic-coated cardboard, corrugated plastic board, and other similar materials on which quality images could not be printed by conventional flexographic printing processes.

It is to be understood that the above described embodiments of the invention are illustrative only and that modifications throughout may occur to those skilled in the art. Accordingly, this invention is not to be regarded as limited to the embodiments disclosed herein, but it to be limited as defined by the appended claims.

What is claimed is:

1. In a flexographic, straight line printing machine comprising a plurality of liquid application stations each comprising a printing cylinder, at least one of which is an upstream ink printing station for the printing of ink images containing a volatile solvent/diluent onto a succession of individual cardboard copy sheets as such sheets are moved therethrough, and at least one of which is a downstream printing station , and means for continuously feeding said individual copy sheets, without bending, through said liquid application stations, the improvement which comprises an intermediate drying station comprising at least one forced hot air means positioned between each of said liquid application stations to apply a line of forced hot air across the direction of travel of said sheets as they move therepast to effect the evaporation of the solvent/diluent from the ink images printed on said cardboard copy sheets prior to the movement of the ink-imaged copy sheets into the next liquid application station, to effect the drying of said images prior to the application of the ink images or a coating thereover.

2. A flexographic, straight line printing machine according to claim 1 in which one or more of the downstream application stations comprise coating stations for the application of spot coatings or continuous coatings, to said copy sheets.

3. A flexographic, straight line printing machine according to claim 1 in which each said intermediate drying station also comprises a vapor extraction means.

4. A flexographic straight line printing machine according to claim 1 which further comprises a final station for cutting the printed cardboard copy sheets.

5. A flexographic, straight-line printing machine according to claim 1 comprising at least two adjacent ink printing stations for printing ink images of different colors in partial or complete registration on said cardboard copy sheets.

6. A method for the flexographic printing of a succession of cardboard copy sheets on a continuous straight line, flexographic printing machine which comprises the steps of continuously feeding a succession of individual cardboard copy sheets, without bending, through a plurality of liquid application stations, each having a printing cylinder, including at least one upstream ink printing station and one or more downstream stations, printing images comprising volatile solvent-/diluent-containing ink onto said copy sheets as they

move through each of said ink-printing stations to form imaged copy sheets, heating said imaged sheets after each ink-printing station by moving them past forced hot air which applies a line of forced hot air across the direction of travel of said sheets to substantially-completely evaporate the volatile solvent/diluent therefrom to form dry imaged copy sheets, prior to movement thereof into the next liquid application station,

7. A method according to claim 6 in which one of said downstream printing stations comprises a coating station in which a coating is applied which covers the dry images printed at the ink printing stations.

8. A method according to claim 7 in which a said coating is applied comprising a partial or spot coating which overlies only a portion of the dry images printed at the ink printing stations.

9. A method according to claim 6 in which drying is accomplished by directing a narrow line of forced hot said air from air knives against said imaged copy sheets.

10. A method according to claim 6 in which the evaporated solvent/diluent is extracted from the area at which it is evaporated.

11. A method according to claim 6 which comprises printing ink images of different colors in partial or complete registration at at least two adjacent ink printing stations.

* * * * *

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United States Patent [19]

DeMoore et al.

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[45] Date of Patent: Jan. 5, 1993

[54] COATING APPARATUS FOR SHEET-FED, OFFSET ROTARY PRINTING PRESSES

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[73] Assignee: Howard W. DeMoore, Dallas, Tex.

[21] Appl. No.: 752,778

[22] Filed: Aug. 30, 1991

[51] Int. Cl.[5] B41F 9/00

[52] U.S. Cl. 101/142; 101/147; 101/232; 101/348; 118/46

[58] Field of Search .... 101/135, 424.1, 142, 101/148, 155, 157, 177, 217, 232, 246, 329, 330, 331, 408, 409, 419, 422, 348-349; 118/46, 211, 236, 249, 257, 258, 261, 262, 263, 206, DIG. 15

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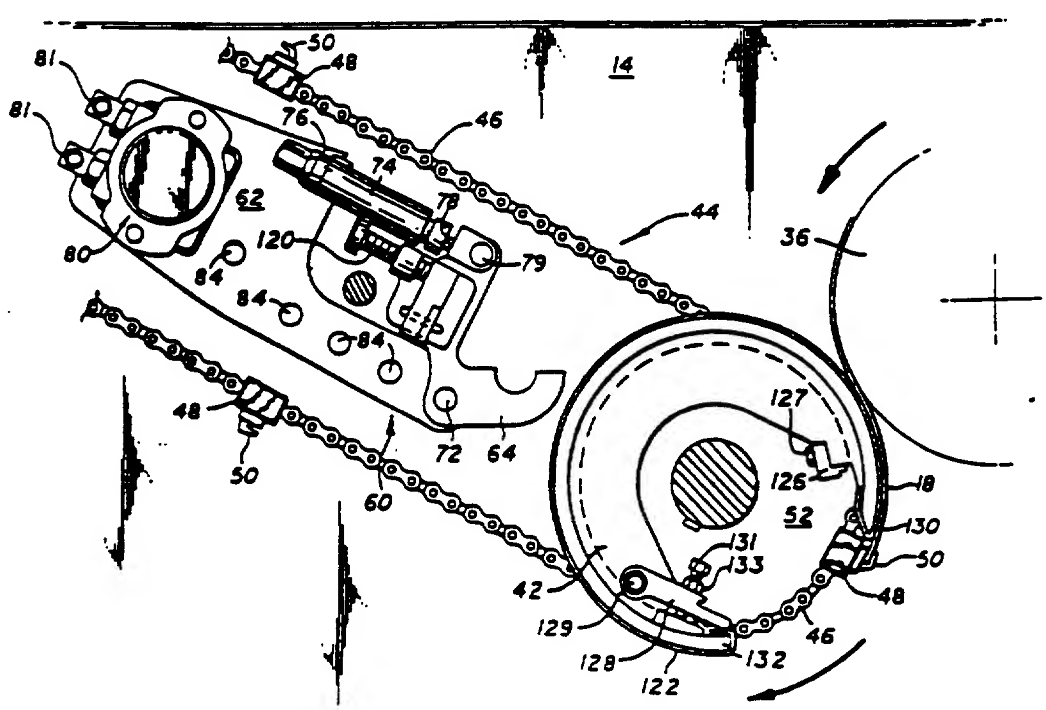
Primary Examiner—Eugene H. Eickholt
Attorney, Agent, or Firm—Dennis T. Griggs

[57] ABSTRACT

A coating apparatus for use in a sheet-fed, offset rotary printing press to selectively apply a protective and/or decorative coating to the wet ink surface of freshly printed sheets and including a coating unit having a pick-up roller for supplying aqueous coating material from a reservoir to the surface of a delivery cylinder mounted on a press delivery drive shaft, the delivery cylinder performing the dual function of a coating applicator roller and a delivery cylinder during coating operations.

22 Claims, 5 Drawing Sheets



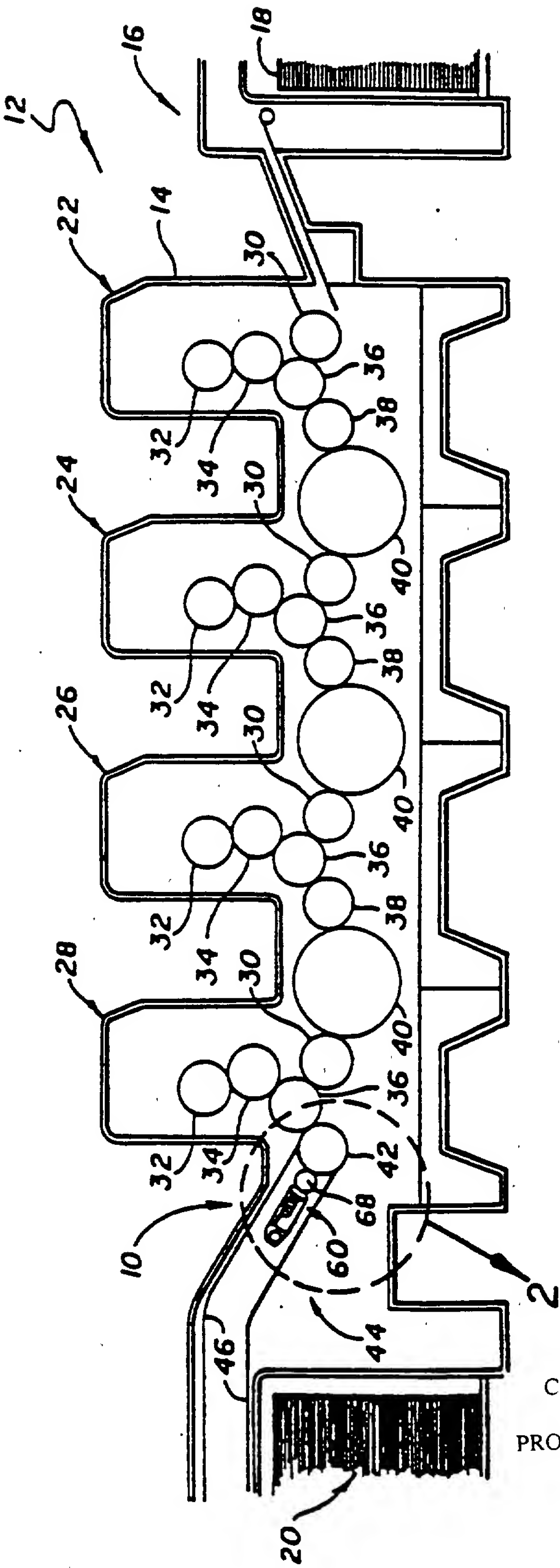
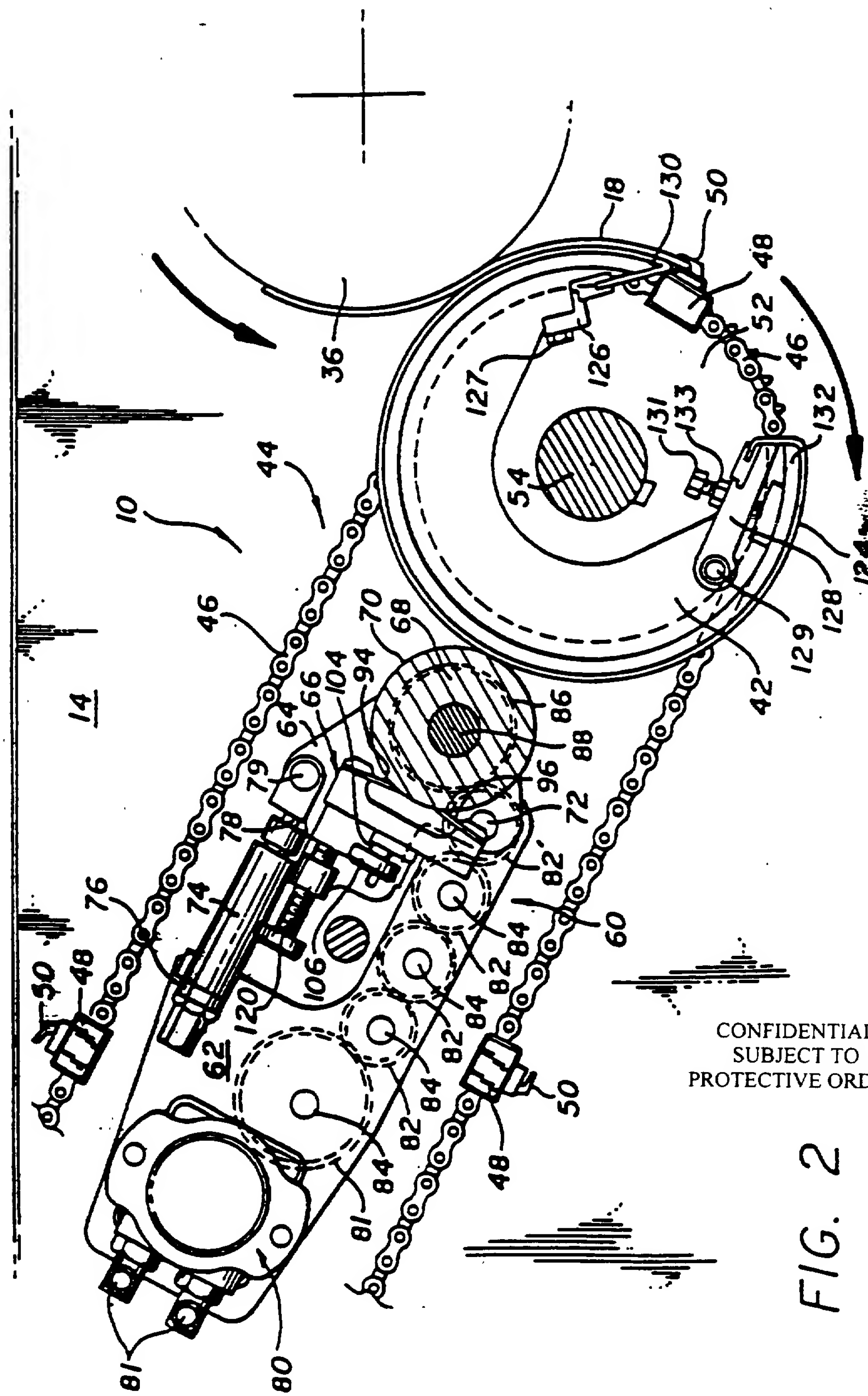


FIG. 1



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PROTECTIVE ORDER

FIG. 2

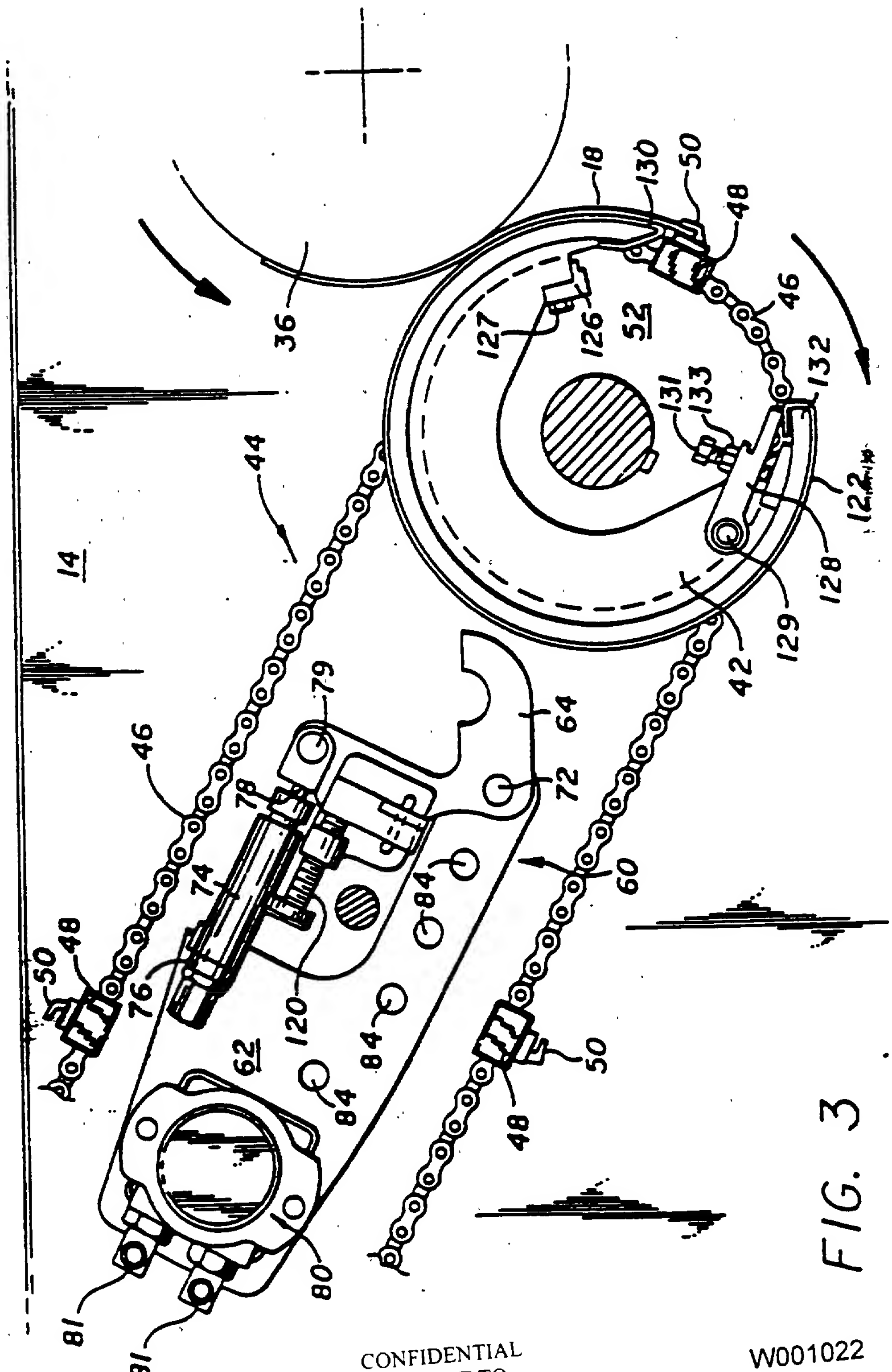
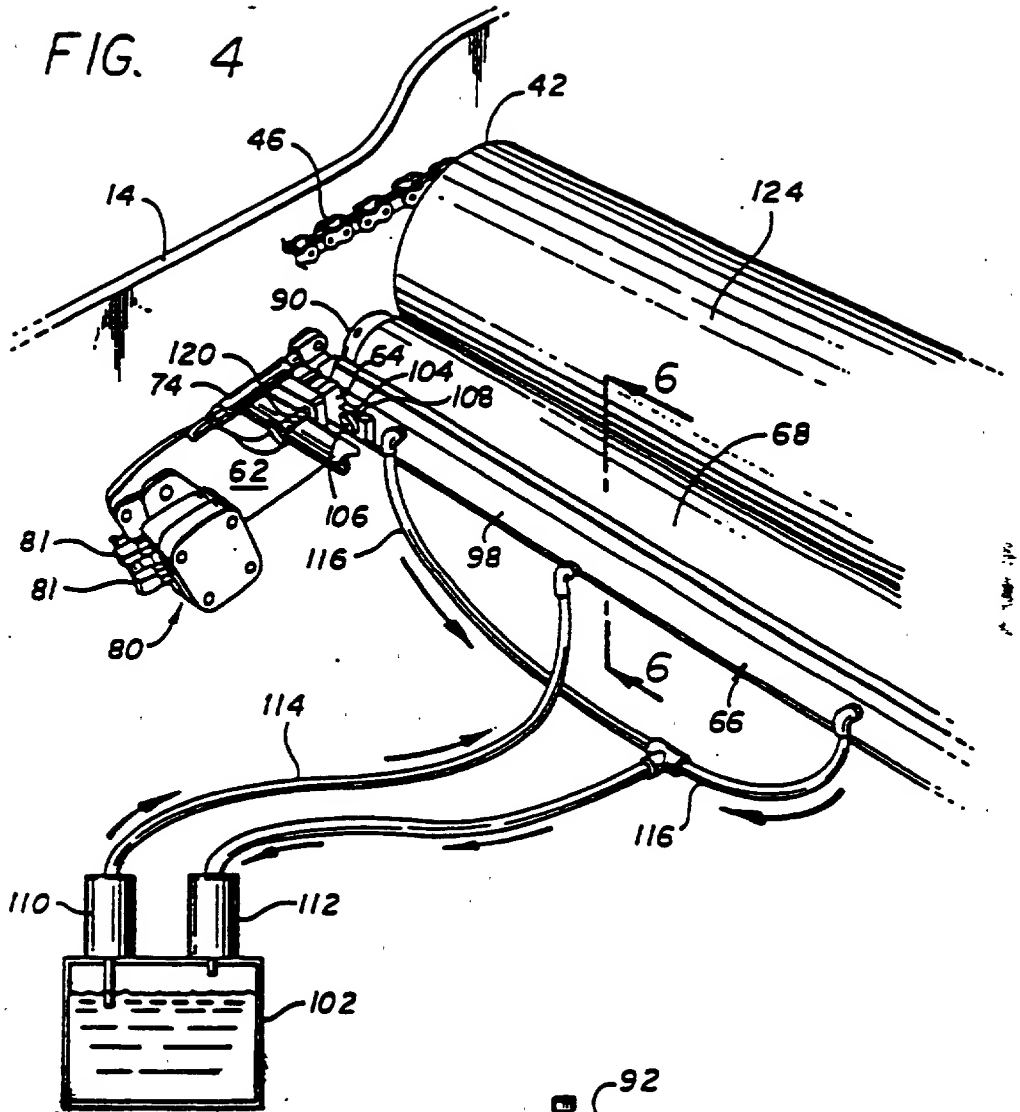


FIG. 3

FIG. 4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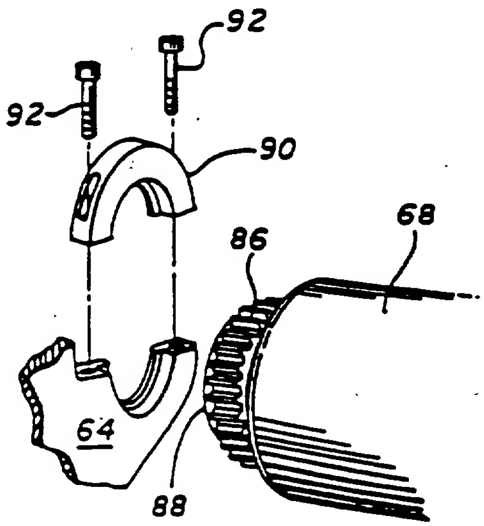
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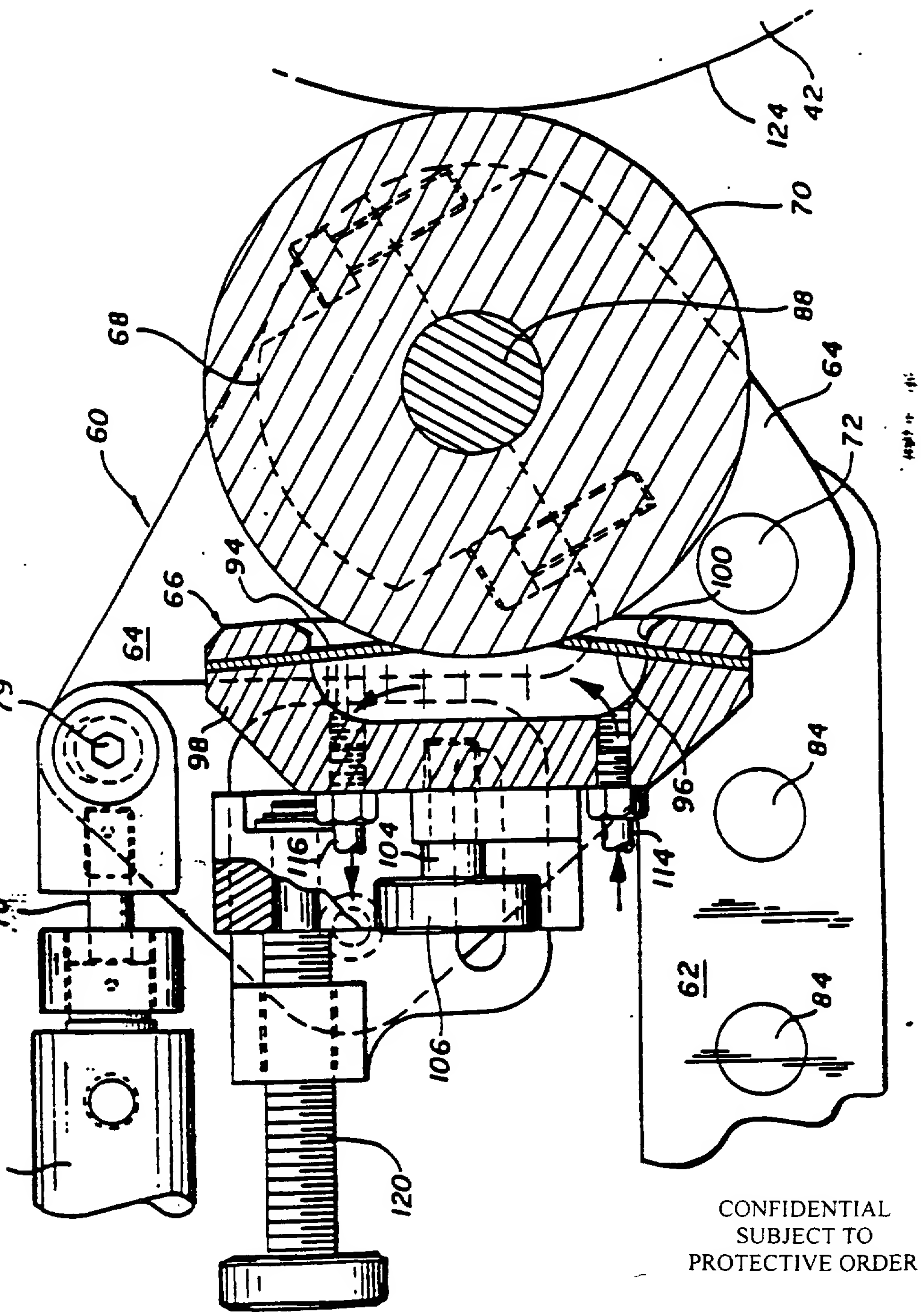
FIG. 5

FIG. 6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COATING APPARATUS FOR SHEET-FED, OFFSET ROTARY PRINTING PRESSES

BACKGROUND OF THE INVENTION

This invention relates to sheet-fed, offset rotary printing presses, and more particularly, to a new and improved apparatus for the in-line application of protective and decorative coatings to the printed surface of freshly printed sheets.

Conventional sheet-fed, offset rotary printing presses typically include one or more printing stations through which individual sheets are fed and printed with wet ink. After final printing, the sheets are fed by a delivery conveyor system to the delivery end of the press where the freshly printed sheets are collected and stacked. In a typical sheet-fed, offset rotary printing press such as the Heidelberg Speedmaster line of presses, the delivery conveyor system includes a pair of endless gripper chains carrying laterally spaced gripper bars and grippers which are used to grip and pull freshly printed sheets from the impression cylinder and convey the sheets toward the sheet delivery stacker. The gripper chains are driven in precisely timed relation to the impression cylinder by gripper chain sprocket wheels laterally spaced between a delivery drive shaft mounted on opposite sides of the press frame, the delivery drive shaft being mechanically coupled by gears for synchronous rotation with the impression cylinder.

Since the inks used with offset type printing presses typically remain wet and tacky for some time after printing, special precautions must be taken to insure that the wet inked surface of the freshly printed sheets are not marked or smeared as the sheets are transferred from one printing station to another, and through the delivery system to the sheet delivery stacker. One system for insuring that the freshly printed sheets are not marked or smeared during transfer is the transfer or delivery cylinder system marketed by Printing Research, Inc., of Dallas, Texas under its registered trademark "SUPER BLUE" That system, which is made and sold under license, is made in accordance with and operates as described in U.S. Pat. No. 4,402,267, issued Sep. 6, 1983 to Howard W. DeMoore, the disclosure of which is incorporated herein by this reference. In that system, marking and marring of freshly printed sheets is prevented by employing transfer or delivery cylinders provided with a coating of friction reducing material such as PTFE (Teflon) over which are loosely mounted fabric covers, referred to in the trade as "nets", and which support the wet ink side of the freshly printed sheets as they are pulled from the impression cylinder. Typically, in a multi-color press employing the "SUPER BLUE" cylinder system, each transfer cylinder for conveying the freshly printed sheets from one printing station to the next is supplied with a "SUPER BLUE" transfer cylinder system, and the delivery cylinder for conveying the sheets from the last printing station to the sheet delivery stacker is supplied with a "SUPER BLUE" delivery cylinder system. As used hereinafter, the term "net type cylinder" is intended to refer to cylinders having fabric nets disposed over the support surface, such as of the general type disclosed in the aforementioned DeMoore U.S. Pat. No. 4,402,267 and exemplified by the "SUPER BLUE" cylinder system.

Another system which can be used to prevent marking and smearing of the freshly printed sheets is that disclosed in U.S. application Ser. No. 07/630,308 filed Dec. 18, 1990 entitled Vacuum Transfer Apparatus for Sheet-Fed Printing Presses now U.S. Pat. No. 5,127,329. That application, the disclosure of which is also incorporated herein by reference, discloses an apparatus which can be employed to draw the unprinted side of a freshly printed sheet into engagement with rollers which support the sheet on the unprinted side during transfer or delivery of the sheet from the impression cylinder after printing so that the wet ink on the freshly printed sheet does not come in contact with other apparatus in the press. The vacuum transfer apparatus disclosed in that application can be used as an alternative to the net type cylinder system disclosed in the aforementioned DeMoore patent, or when used in a perfecting press, as a supplement to that system, the vacuum transfer apparatus being primarily intended for use when only one-sided sheet printing is being performed by the press, and the net type cylinder system being used when the press is operating in the perfector mode with two-sided sheet printing.

In some printing applications, it is desirable that the press be capable of applying a protective and/or decorative coating over all or a portion of the surface of the printed sheets. Such coatings typically are formed of a UV-curable or water-soluble resin applied as a liquid solution or emulsion by an applicator roller over the freshly printed sheets to protect the ink and improve the appearance of the sheets. Use of such coatings is particularly desirable when decorative or protective finishes are required such as in the production of posters, record jackets, brochures, magazines, folding cartons and the like. In cases where a coating is to be applied, the coating operation is carried out after the final ink printing has been performed, most desirably by an in-line coating application, rather than as a separate step after the printed sheets have been delivered to the sheet delivery stacker.

Various suggestions have been made for applying the coating as an in-line press operation by using the final printing station of the press as the coating application station. For example, in U.S. Pat. Nos. 4,270,483, 4,685,414, and 4,779,557 there are disclosed coating apparatus which can be moved into position to allow the blanket cylinder of the last printing station of a press to be used to apply a coating material to the sheets. In U.S. Pat. No. 4,796,556 there is disclosed a coating apparatus which can be selectively moved between the blanket cylinder or the plate cylinder of the last printing station of the press so that that station can be used as a coating station for the press. However, when coating apparatus of these types are used, the last printing station can not be used to apply ink to the sheets, but rather can only be used for the coating operation. Thus, with these types of in-line press coating apparatus, the press loses the capability of printing its full range of colors since the last printing station is converted to a coating station.

Suggestions for overcoming the problem of the loss of a printing station when coating is desired have also been made, such as that set forth in U.S. Pat. Nos. 4,934,305 which discloses a coating apparatus having a separate timed applicator roller positioned to apply the coating material to the printed sheet while the sheet is on the last impression cylinder of the press. This is said to allow the last printing station to be operated simultaneously as both an ink application station and a coating

station so that no loss of press printing unit capability results. Another approach to providing a coating station without loosing the printing capabilities of the last printing station is to provide a totally separate coating unit down stream of the last printing station so that the coating is applied to the sheets after final printing and before the sheets have reached the sheet delivery stacker. Such an approach is suggested in U.S. Pat. Nos. 4,399,767 and 4,706,601. While each of these suggestions provide coating stations which allow the final printing station to continue to be used for printing, they each suffer from the disadvantages of requiring the provision of separately driven coating applicator rollers and apparatus which must be precisely timed in relation to the movement of the sheet to be coated so as to insure precise registration between application of the coating material and the printed sheet. The provision of separate timed applicator rollers require that the presses be modified to provide sufficient space within the presses to accommodate the added coating apparatus or to increase the length of the presses, and require additional and complex drive connections with the press drive system to achieve the required precise speed correlation between the sheets and the applicator rollers. Such modifications can be both expensive and cumbersome to install and maintain.

Thus, there exists a need for a new and improved in-line apparatus for use in a sheet-fed, offset rotary printing press to selectively apply a protective and/or decorative coating to the printed surface of freshly printed sheets which allows the final press printing station to continue to be used as a printing station, yet which does not require any substantial press modification or the addition of a separate timed applicator roller. As will be explained in more detail hereinafter, the present invention solves this need in an novel and unobvious manner.

SUMMARY OF THE INVENTION

The present invention provides a new and improved in-line apparatus for selectively applying a protective and/or decorative coating to the surface of freshly printed sheets in a sheet-fed, offset rotary printing press which is highly reliable and effective in use, yet which does not require any expensive or substantial press modification or result in any impairment of normal press operating capability. The present invention enables the press to be used to selectively apply the coating material to the freshly printed sheets as the sheets are conveyed from the impression cylinder of the last printing station of the press toward the sheet delivery stacker by utilizing a delivery cylinder mounted to the existing press delivery drive shaft to perform the dual function of a coating material applicator roller and a sheet delivery cylinder so that no modification of the press is required to enable the press to be used for either coating or noncoating operation, and without impairment of any normal press operations.

More specifically, the present invention is intended for use in a sheet-fed, offset rotary printing press of the type having at least one printing station which includes a blanket cylinder and an impression cylinder disposed for printing ink onto sheets passing therebetween, and a delivery conveyor system for pulling freshly printed sheets off the impression cylinder and transporting the sheets toward the press sheet delivery stacker. For use of the present invention, the press must include a delivery drive shaft disposed adjacent to and extending parallel with the impression cylinder, and which is driven in timed synchronous relation with the impression cylinder.

In accordance with the invention, a delivery cylinder is mounted to the delivery drive shaft and provided with a coating blanket disposed over the peripheral outer surface of the cylinder, and adapted to engage and support the wet ink side of a freshly printed sheet. A coating apparatus including a supply of liquid coating material and a pick-up roller disposed to receive coating material from the supply, is mounted to the press and operable to permit the pick-up roller to be moved into engagement with the delivery cylinder so that coating material on the pick-up roller is transferred to the coating blanket of the delivery cylinder and then to the freshly printed sheet.

Preferably, the coating apparatus is mounted to the press downstream of the delivery drive shaft, and includes means to selectively move the pick-up roller into and out of engagement with the delivery cylinder. When the pick-up roller is not in the operable position in engagement with the delivery cylinder, the delivery cylinder can be used for conventional noncoating sheet delivery by removing the coating blanket and, preferably, replacing the coating blanket with a fabric net such as of the net type cylinder system previously described. To convert to a coating operation, the coating blanket is attached to the delivery cylinder and, depending upon the thickness of the sheets to be printed, packed with suitable packing sheets to increase the effective diameter of the cylinder so that pressure is applied to the freshly printed sheets against the impression cylinder by the coating blanket covered delivery cylinder. The pick-up roller is then moved to the operative position engaged with the delivery cylinder so that as freshly printed sheets are pulled by the delivery conveyor from the impression cylinder around the delivery cylinder, coating material applied to the delivery cylinder by the pick-up roller is transferred to the freshly printed sheets in the nip between the delivery cylinder and the impression cylinder.

Since the delivery cylinder is driven by the delivery drive shaft in precise timed relation with the impression cylinder, exact registration between the application of coating material and the printed sheet is assured. Further, since the coating of the freshly printed sheets is carried out through use of a delivery cylinder mounted to the existing press delivery drive shaft, no substantial press modifications are required, and the press can be quickly and easily converted between coating and noncoating operation with no loss of printing capability of the final printing station.

Many other features and advantages of the present invention will become more apparent from the following detailed description take in conjunction with the accompanying drawings which disclose, by way of example, the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic side elevational view of a sheet-fed, offset rotary printing press having a coating apparatus embodying the present invention;

FIG. 2 is an enlarged fragmentary side elevational view taken substantially within the circular area designated "2" in FIG. 1 and showing the coating apparatus of the present invention during coating operation;

FIG. 3 is a side elevational view similar to FIG. 2, but showing the coating apparatus in the inoperative posi-

tion with the coating pick-up roller and reservoir removed, and the blanket covering over the delivery cylinder replaced with a fabric net for non-coating printing;

FIG. 4 is an enlarged fragmentary perspective view showing one side of the coating apparatus mounted in the press and illustrating the fluid path of coating material from a supply tank to the reservoir of the coating unit;

FIG. 5 is an enlarged fragmentary perspective view illustrating the end mounting of the coating pick-up roller to its support bracket; and

FIG. 6 is an enlarged fragmentary sectional view taken substantially along the lines 6—6 of FIG. 4.

DETAILED DESCRIPTION OF PRESENTLY PREFERRED EMBODIMENT

As shown in the exemplary drawings, the present invention is embodied in a new and improved in-line apparatus, herein generally designated 10, for selective use in applying a protective and/or decorative coating to the freshly printed surface of sheets printed in a sheet-fed, offset rotary printing press, herein generally designated 12. In this instance, as shown in FIG. 1, the coating apparatus 10 is illustrated as installed in a four color printing press 12, such as that manufactured by Heidelberger Druckmaschinen AG of the Federal Republic of Germany under its designation "Heidelberg Speedmaster 102V (40")," and which includes a press frame 14 coupled at one end, herein the right end, with a sheet feeder 16 from which sheets, herein designated 18, are individually and sequentially fed into the press, and at the opposite end, with a sheet delivery stacker 20 in which the finally printed sheets are collected and stacked. Interposed between the sheet feeder 16 and the sheet delivery stacker 20 are four substantially identical sheet printing stations 22, 24, 26 and 28 which can print different color inks onto the sheets as they are moved through the press 10.

As illustrated, each of the printing stations 22, 24, 26 and 28 is substantially identical and of conventional design, herein including a sheet feed cylinder 30, a plate cylinder 32, a blanket cylinder 34 and an impression cylinder 36, with each of the first three printing stations 22, 24, and 26 having a transfer cylinder 38 disposed to withdraw the freshly printed sheets from the adjacent impression cylinder and transfer the freshly printed sheets to the next printing station via a transfer drum 40. The final printing station 28 herein is shown as equipped with a delivery cylinder 42 which functions to support the printed sheet 18 as it is moved from the final impression cylinder 36 by a delivery conveyor system, generally designated 44, to the sheet delivery stacker 20.

The delivery conveyor system 44 herein is of conventional design and includes a pair of endless delivery gripper chains 46, only one of which is shown in the drawings, carrying at regular spaced locations along the chains, laterally disposed gripper bars 48 having gripper elements 50 used to grip the leading edge of a sheet 18 after it leaves the nip between the delivery cylinder 42 and impression cylinder 36 of the last printing station 28. As the leading edge of the sheet 18 is gripped by the grippers 50, the delivery chains 46 pull the sheet away from the impression cylinder 36 and convey the freshly printed sheet to the sheet delivery stacker 20 where the grippers release the finally printed sheet. The endless delivery chains 46 are driven in synchronous timed relation to the impression cylinder 36 by sprocket

wheels 52 fixed adjacent the lateral ends of a delivery drive shaft 54 which has a mechanically geared coupling (not shown) through the press drive system to the impression cylinder. The delivery drive shaft 54 extends laterally between the sides of the press frame 14 adjacent the impression cylinder 36 of the last printing station 28, and is disposed to be parallel with the axis of the impression cylinder. In this instance, the delivery cylinder 42, which is constructed to allow adjustments in diameter by suitable means, is fixedly mounted to the delivery drive shaft 54 so that the delivery cylinder is also rotated in precise timed relation to the impression cylinder.

Preferably, each of the transfer cylinders 38 is equipped with an anti-marking system such as the aforementioned net type transfer cylinder system or the press 12 can be supplied in the transfer positions with vacuum transfer systems of the type disclosed in the above-identified copending U.S. application Ser. No. 07/630,308 filed Dec. 18, 1990, although as will become more apparent hereinafter, the use of such transfer systems is not required for the present invention and other types of transfer systems can be used. For reasons that will become more apparent hereinafter, for most effective use of the present invention, however, the delivery cylinder 42 should be of the type which employs the "SUPER BLUE" delivery cylinder system, or, as an alternative, should employ in the delivery position, a vacuum transfer system such as disclosed in the above-identified copending U.S. application Ser. No. 07/630,308.

In this respect, it is important to note that when the freshly printed sheets 18 are conveyed away from the impression cylinder 36 of the final printing station 28 by the gripper 50 carried by the delivery chains 46, the wet inked surfaces of the sheets face the delivery drive shaft 54 and the sheets must be supported such that the ink is not marked or smeared as the sheets are transferred. Typically, such support is provided by skeleton wheels or cylinders mounted to the press delivery drive shaft 54, or as is now more commonly used, net type delivery cylinders such as of the "SUPER BLUE" delivery cylinder system type disclosed in the aforementioned DeMoore patent. More recently, vacuum transfer apparatus of the type disclosed in the aforementioned copending U.S. application Ser. No. 07/630,308 have been used in place of delivery cylinders or skeleton wheels to pull the unprinted side of the sheet away from the delivery drive shaft 54 so that the wet ink surface of the sheets do not come into contact with any press apparatus. It has been found, however, that when a protective or decorative coating material is applied to the wet ink surface of the sheets, the coating protects the wet ink against marking and smearing such that the coating applicator roller itself can be used to support the wet inked surface of the sheets without fear of damage to the freshly printed surface.

In accordance with the present invention, the in-line coating apparatus 10 for selectively applying the protective or decorative coating to the sheets 18 enables the press 12 to be operated in the normal manner without the loss of the final printing station 28, and without requiring any substantial press modifications by employing the existing press delivery drive shaft 54 as the mounting location for the coating applicator roller. In presses 12 utilizing a net type delivery cylinder system, that system can be quickly and easily converted to perform the dual function of being a coating applicator roller and a delivery cylinder. In presses having other

types of delivery systems such as skeleton wheels mounted on the delivery drive shaft 54 or a vacuum transfer apparatus as disclosed in the aforementioned copending U.S. application Ser. No. 07/630,308, conversion to a coating operation can be quickly and easily achieved by mounting on the press delivery drive shaft in place of the skeleton wheels or in addition to the vacuum transfer apparatus, a suitable support cylinder capable of performing the combined function of a coating applicator roller and a delivery cylinder 42. Typically, such a support cylinder will have a diameter which provides no more than about a 0.090 inch clearance between the cylinder support surface and the adjacent impression cylinder 36. By utilizing the delivery cylinder 42 mounted on the delivery drive shaft 54 to also act as a coating applicator roller, the present invention insures that the coating will be applied to the printed sheet 18 in precise timed registration, and will permit the press to be operated with its full range of printing stations, yet allow fast, simple and convenient change-over from coating to noncoating operations, and vice versa, with a minimum of press down time.

Toward these ends, the coating apparatus 10 of the present invention includes a relatively simple, positive acting and economical coating unit, generally designated 60, mounted to the press frame 14 down stream of the delivery drive shaft 54 and positioned to selectively supply coating material to the support surface of a delivery cylinder 42 mounted on the delivery drive shaft. As best can be seen in FIGS. 2, 4 and 6, the coating unit 60 herein comprises a pair of side frames 62, only one of which is shown, it being understood that the other side frame is substantially the same as that of the side frame illustrated, attached to each side of the press frame 14. Pivotally mounted to one end of each of the side frames 62 is a support bracket 64 carrying one end of a coating material reservoir 66 and cooperating coating material pick-up roller 68 each disposed to extend laterally across the press 12 parallel with the delivery drive shaft 54. The coating unit 60 is mounted between the upper and lower runs of the delivery chains 46 down stream of the delivery drive shaft 54, and positioned so that the outer peripheral surface 70 of the pick-up roller 68 can be frictionally engaged with the support surface of a delivery cylinder 42 mounted on the delivery drive shaft.

As best seen in FIGS. 2 through 4, the support bracket 64 is pivotally attached to the end of the side frame 62 by a shaft 72 disposed at the lower end portion of the bracket and can be pivoted about the shaft by an extensible cylinder 74, herein shown as a hydraulic cylinder, one end 76 of which is secured such as by welding to the side frame, and the opposite end 78 of which is coupled through a pivot shaft 79 to the upper end portion of the bracket. By extending or retracting the cylinder 74, the extent of frictional engagement of the pick-up roller 68 with the surface of the delivery cylinder 42 can be controlled, and the pick-up roller can be completely disengaged from the delivery cylinder.

The coating pick-up roller 68, which can be of conventional design and preferably one such as the Anilox rollers manufactured by A.R.C. International of Charlotte, N.C., and sold under the name "PRINTMASTER" having an engraved ceramic or chrome outer peripheral surface 70, is designed to pick up a predetermined uniform thickness of coating material from the reservoir 66, and then uniformly transfer the coating to the support surface of the delivery cylinder 42. To effect rotation of the pick-up roller 68, a suitable motor 80, herein a hydraulic motor, is attached to one of the side frames 62 and coupled to a suitable hydraulic fluid source (not shown) through fittings 81. Attached to the output of the motor 80 is an output gear which is drivingly coupled through a reduction gear 81 and a series of idler gears 82 each mounted on stub axles 84, to a drive gear 86 attached to the end of a shaft 88 on which the pick-up roller 68 is concentrically mounted. The shaft 88 of the pick-up roller 68 is, in turn, journaled at each end to the brackets 64 through a releasable semicircular collar 90 (see FIG. 5) attached by bolts 92 to the bracket. Herein, the axle of the terminal idler gear, designated 82', also serves as the shaft 72 for pivotally mounting the support bracket 64 to the side frame 62 so that when the bracket is rotated about the shaft, the terminal idler gear remains engaged with the drive gear 86 of the pick-up roller 68.

In this instance, as best as can be seen in FIG. 6, the pick-up roller 68 has a portion which projects laterally into the reservoir 66 containing the supply of coating material, and a pair of upper and lower inclined doctor blades 94 and 96 attached to the reservoir engage the roller surface to meter the coating material picked up from the reservoir by the etched surface 70 of the roller. The reservoir 66 herein is formed by an elongated, generally rectangular housing 98 having a generally C-shaped cross-section with a laterally extending opening 100 along one side facing the pick-up roller 68, and is supplied with coating material from a supply tank 102 disposed in a remote location within or near the press 12. Preferably, the reservoir 66 is removably attached to the brackets 64, herein by bolts 104 having enlarged, knurled beads 106, and which can be threaded through slots 108 formed in the brackets to clamp the reservoir in place on the brackets.

To insure that an adequate supply of coating material is always present within the reservoir 66 and to prevent coagulation and clogging of the doctor blades 94 and 96 by the aqueous coating material, the coating material is circulated through the reservoir, herein by two substantially identical pumps 110 and 112, one of which pumps coating material from the supply tank 102 via a supply line 114 to the bottom of the reservoir, and the other of which acts to provide suction to a pair of return lines 116 coupled adjacent the top of the reservoir for withdrawing unused coating material from the reservoir. By circulating the coating material from the supply tank 102 at a greater rate than the rate of withdrawal of material by the pick-up roller 68, a substantially constant supply of coating material will always be present within the reservoir 66.

In this instance, the general arrangement of the pick-up roller 68, doctor blades 94 and 96, and reservoir 66 is substantially like that disclosed in U.S. Pat. No. 4,821,672 entitled DOCTOR BLADE ASSEMBLY WITH ROTARY END SEALS AND INTERCHANGEABLE HEADS", the disclosure of which can be reviewed for details concerning the structure and operation of a pick-up roller and reservoir usable with the present invention.

Once the coating unit 60 has been installed in a press 12, which basically only requires that the side frames 62 be attached, such as with bolts, to the sides of the press frame 14, and the hydraulic motor 80 be coupled with a suitable hydraulic source, the press can be quickly and easily converted to the coating mode. In presses 12 already supplied with a net type delivery cylinder sys-

tem, to convert to a coating operation, all that is necessary is that the fabric net material (designated 122 in FIG. 3) normally used over the support surface of the net type delivery cylinder during noncoating press operations, be removed and replaced with a coating blanket 124 capable of transferring coating material deposited thereon onto the printed sheets. Typically, such a blanket 124 can be formed as a rubber covering such as used for the covering surface of the conventional blanket cylinders 34 of the press 12. In presses 12 having conventional skeleton wheels or a vacuum transfer type apparatus such as that of the aforementioned copending U.S. application Ser. No. 07/630,308, a suitable delivery cylinder 42 can be fixed to the delivery drive shaft 54 and a similar coating blanket 124 applied thereto over the cylinder surface.

It is important to note that during nonprinting operations, the net type delivery cylinder 42 does not engage the surface of the impression cylinder 36 during sheet delivery. However, when used as a coating applicator roller during coating operations, the effective diameter of the delivery cylinder 42 must be increased so that the coating blanket 124 presses the sheet 18 against the surface of the impression cylinder 36, as shown in FIG. 2. To increase the effective diameter of the delivery cylinder 42, the thickness of the coating blanket 124 applied over the support surface of the delivery cylinder 42 can be selected to correspond with the thickness of the sheets 18 to be printed, or suitable packing sheets, such as paper sheets (not shown) of the type conventionally used in conjunction with press blanket cylinders 34, can be interposed between the delivery cylinder and the coating blanket.

While any suitable means can be used to attached the coating blanket 124 to the support surface of the delivery cylinder 42, in this instance, as shown in FIGS. 2 and 3, the delivery cylinder is supplied with clamps 126 attached by bolts 127 to the cylinder adjacent the leading edge 130 to secure the leading edge of the coating blanket 124 to the cylinder, and adjustable tensioning clamps 128 are provided adjacent the cylinder trailing edge 132 for securing the trailing edge of the blanket to the cylinder. However, the tensioning claims 128 are pivotally mounted at one end by a pin 129 to the cylinder 42, and the blanket tension is adjusted through a bolt 131 and nut 133 arrangement. Depending upon the thickness of the sheets 18 to be printed and coated by the press 12, one or more layers of packing paper or the like may be interposed between the support surface of the delivery cylinder 42 and the coating blanket 124 to increase the effective diameter of the cylinder. Provision of the tensioning clamps 128 for attaching the coating blanket 124 to the leading edge 132 of the delivery cylinder 42 allows for such control and adjustment.

Once installed, the coating unit 60 can remain in position even though the press 12 is operated in the non-coating mode. In this respect, when the coating unit 60 is not in operation, the extensible cylinder 74 can be actuated to pivot the support brackets 64 carrying the pick-up roller 68 and reservoir 66 about the shaft 72 and away from the delivery cylinder 42, thus rendering the coating unit inoperative. This then also frees the pick-up roller 68 and reservoir 66 for fast and easy removal from the coating unit 60 for cleaning, service or replacement. To remove the pick-up roller 68, the coating material is drained from the reservoir 66, and the pressure exerted by the doctor blades 94 and 96 against the roller is released, therein through operation

of a pressure adjustment screw 120 attached to the reservoir, and the bolts 92 and collars 90 are removed, thereby permitting the pick-up roller to be lifted from the coating unit 60. To remove the reservoir 66, all that need be done is to release the mounting bolts 104 securing the reservoir to the brackets 64. With the coating unit 60 moved by the extensible cylinder 74 to the inoperative position, the delivery cylinder 42 can be converted for normal delivery cylinder operation simply by removing the coating blanket 124 from the delivery cylinder 42 and replacing the blanket with a fabric net 122. Alternatively, if a vacuum transfer apparatus such as described in the aforementioned copending U.S. application Ser. No. 07/630,308 is installed in the press 12, that apparatus can be activated to deliver sheets from the impression cylinder 36 without effecting any delivery cylinder change since the freshly printed side of the sheets will not come into contact with the delivery cylinder.

In a typical noncoating operation of the press 12 with the coating apparatus 10 installed, the coating unit 60 will be in the inoperative position. In that situation and with a net type delivery cylinder 42 installed, the delivery cylinder will be covered with the fabric net 122 so that the delivery cylinder operates in the normal manner with the wet ink side of the freshly printed sheets 18 being supported by the net covered surface of the delivery cylinder. Should the press 12 include a vacuum transfer apparatus such as disclosed in the aforementioned copending U.S. application Ser. No. 07/630,308, the delivery cylinder 42 can remain on the delivery drive shaft 54, with or without a fabric net 122, depending upon whether or not the press is used for perfector printing.

When it is desired to convert to the coating mode of operation, the press 12 is stopped just long enough to replace the fabric net 122 on the delivery cylinder 42 with the coating blanket 124 packed to the required extent necessary for providing the proper pressure to effect coating of the sheet thickness to be printed. Thereafter, the pumps 110 and 112 are activated and the press 12 re-started. The extensible cylinder 74 can then be activated to control the pressure of the pick-up roller 68 against the delivery cylinder 42 to obtain the desired application of coating material to the freshly printed sheets 18.

Notably, with the coating apparatus 10 of the present invention, no timing adjustments between the delivery cylinder 42 and the impression cylinder 36 are required to achieve and maintain precise registration between application of the coating material and the printed surface of the sheets 18. Further, the coating unit 60 permits a wide range of coating weights to be applied to the printed sheets 18 by quickly and easily changing pick-up rollers 68 from those designed to produce a very light coating application to those designed to produce a very thick coating application can be used.

From the foregoing, it should be apparent that the coating apparatus 10 of the present invention provides a highly reliable, effective and economical in-line apparatus for selectively applying coating material to the freshly printed sheets 18 in a sheet-fed, offset rotary printing press 12 which allows the final printing station to continue to be used as a print station, yet which does not require any substantial press modification or the addition of a separate timed applicator roller. While a particular form of the present invention has been illustrated and described, it should be apparent that varia-

tions and modifications therein can be made without departing from the spirit and scope of the invention.

We claim:

1. In a sheet-fed, offset rotary printing press of the type including at least one printing station having a blanket cylinder and an impression cylinder disposed for printing ink onto sheets passing therebetween, and a delivery conveyor system for pulling freshly printed sheets from the impression cylinder and transporting the printed sheets toward a sheet delivery stacker, the delivery conveyor system including a delivery drive shaft disposed adjacent to and extending parallel with the impression cylinder and driven in timed synchronous relation with the impression cylinder, the improvement comprising:

- a delivery cylinder mounted to said delivery drive shaft and having an outer peripheral support surface adapted to engage and support a sheet being transported by said delivery conveyor system;
- a coating apparatus including a supply of liquid coating material, a rotatable pick-up roller having an outer peripheral surface of substantially cylindrical shape, and means for applying a coating of liquid coating material from said supply onto said outer peripheral surface of said pick-up roller; and
- means for mounting said coating apparatus to the press adjacent said delivery cylinder including selectively operable means for moving said pick-up roller between a first operable position with a portion of said peripheral surface of said pick-up roller engaged with said support surface of said delivery cylinder, and a second inoperable position with said peripheral surface out of engagement with said support surface of said delivery cylinder, whereby when said pick-up roller is in said first operable position, liquid coating material from said supply applied onto said peripheral surface of said pick-up roller is transferred to said support surface of said delivery cylinder and to said freshly printed sheet.

2. The improvement as set forth in claim 1 wherein said delivery cylinder includes a coating blanket disposed over said peripheral support surface.

3. The improvement as set forth in claim 1 wherein said delivery cylinder includes a removable coating blanket disposed over said peripheral support surface when said pick-up roller is in said first operable position.

4. The improvement as set forth in claim 3 wherein said coating blanket has a rubber outer surface.

5. The improvement as set forth in claim 3 wherein said delivery cylinder includes a fabric net disposed over said peripheral support surface when said pick-up roller is in said second inoperable position.

6. The improvement as set forth in claim 1 wherein said coating apparatus includes an elongated reservoir containing said supply of liquid coating material, said reservoir being disposed to extend parallel with said pick-up roller with a portion of said peripheral surface extending into said reservoir in contact with liquid coating material contained therein, and at least one doctor blade attached to said reservoir and engaging said peripheral surface, said doctor blade acting to limit the amount of liquid coating material applied onto said peripheral surface from said reservoir.

7. The improvement as set forth in claim 6 wherein said reservoir and said pick-up roller are movably coupled to said press and said selectively operable means includes an extensible cylinder coupled between said reservoir and said press and operable to move said reservoir and said pick-up roller between said first and second positions.

8. The improvement as set forth in claim 7 wherein said pick-up roller is rotatably driven by a motor attached to said coating apparatus.

9. The improvement as set forth in claim 8 wherein said delivery cylinder includes a rubber coating blanket disposed over said peripheral support surface when said pick-up roller is in said first operable position, and includes a fabric net disposed over said peripheral support surface when said pick-up roller is in said second inoperable position.

10. The improvement as set forth in claim 9 wherein said coating apparatus is mounted to said press downstream of said delivery drive shaft in the direction of travel of said sheets during transport by said delivery conveyor system.

11. The improvement as set forth in claim 1 wherein said mounting means includes first and second side frames mounted on said press, a support shaft mounted on and extending between said first and second side frames, a support bracket attached to said coating apparatus and movably coupled to said support shaft for pivotal movement between said first and second positions, and said selectively operable means includes an extensible cylinder coupled between said coating apparatus and said support bracket and operable to move said coating apparatus toward and away from said delivery cylinder.

12. In a sheet-fed, offset rotary printing press of the type including at least one printing station having a blanket cylinder and an impression cylinder disposed for printing wet ink onto sheets passing therebetween, and a delivery conveyor system for pulling freshly printed sheets from the impression cylinder and transporting the printed sheets toward a sheet delivery stacker, the delivery conveyor system comprising a pair of endless gripper chains disposed on opposite sides of the press and supporting therebetween gripper bars and grippers spaced along the chains, the gripper chains being driven in timed synchronous relation with the impression cylinder by laterally spaced sprocket wheels mounted on opposite ends of a delivery drive shaft disposed adjacent to and extending parallel with the impression cylinder, the improvement comprising:

- a delivery cylinder mounted to said delivery drive shaft between said sprocket wheels and having an outer peripheral support surface covered by a removable coating blanket adapted to engage and support the wet ink side of a sheet being transported by said gripper bars;
- a coating apparatus including a supply of liquid coating material, a rotatable pick-up roller having an outer peripheral surface of substantially cylindrical shape communicating with said supply, and means for applying liquid coating material from said supply onto said peripheral surface of said pick-up roller; and,
- means for mounting said coating apparatus to the press adjacent the delivery cylinder, said means including selectively operable means for moving said coating apparatus between a first operable position with a portion of said peripheral surface of said pick-up roller engaged with said delivery cylinder, and a second inoperable position with said peripheral surface of said pick-up roller out of engagement with said delivery cylinder, whereby when said coating apparatus is in said first operable

position, liquid coating material from said supply metered onto said peripheral surface of said pick-up roller is transferred to said delivery cylinder and to said freshly printed sheet, and when said coating apparatus is in said second inoperable position, said delivery cylinder is disposed for non-coating sheet delivery operation.

13. The improvement as set forth in claim 12 wherein the effective diameter of said delivery cylinder covered by said coating blanket is sufficient to apply pressure to sheets against said impression cylinder as said sheets are pulled from said impression cylinder by said gripper bars.

14. The improvement as set forth in claim 13 wherein said coating blanket has a rubber outer support surface.

15. The improvement as set forth in claim 14 wherein said coating apparatus is disposed downstream of said delivery drive shaft in the direction of travel of said sheets during transport by said delivery conveyor system.

16. A sheet-fed, offset rotary printing press including:

at least one printing station having a blanket cylinder and an impression cylinder disposed for printing wet ink onto sheets passing therebetween;

a delivery conveyor system for pulling freshly printed sheets from the impression cylinder and transporting the printed sheets toward a sheet delivery stacker, the delivery system including a delivery drive shaft;

a delivery cylinder mounted to said delivery drive shaft and having an outer peripheral support surface adapted to engage and support a sheet being transported by said delivery conveyor system;

a coating apparatus including a supply of liquid coating material, a rotatable pick-up roller having an outer peripheral surface of substantially cylindrical shape communicating with said supply, and means for applying liquid coating material from said supply onto said peripheral surface of said pick-up roller; and

means for mounting said coating apparatus to the press adjacent said delivery cylinder, said means including selectively operable means for moving said pick-up roller between a first operable position

with a portion of said peripheral surface of said pick-up roller engaged with said delivery cylinder, and a second inoperable position with said peripheral surface of said pick-up roller out of engagement with said delivery cylinder, whereby when said pick-up roller is in said first operable position, liquid coating material from said supply applied to said peripheral surface of said pick-up roller is transferred to said delivery cylinder and then to said freshly printed sheet.

17. A sheet-fed, offset rotary printing press as set forth in claim 16 wherein said delivery cylinder includes a removable coating blanket disposed over said peripheral support surface when said pick-up roller is in said first operable position.

18. A sheet-fed, offset rotary printing press as set forth in claim 17 wherein said coating blanket has a rubber outer surface.

19. A sheet-fed, offset rotary printing press as set forth in claim 17 wherein said delivery cylinder includes a fabric net disposed over said peripheral support surface when said pick-up roller is in said second inoperable position.

20. A sheet-fed, offset rotary printing press as set forth in claim 19 wherein said coating apparatus includes an elongated reservoir containing said supply of liquid coating material, said reservoir being disposed to extend parallel with said pick-up roller with a portion of said peripheral surface extending into said reservoir in contact with liquid coating material contained therein, and at least one doctor blade attached to said reservoir and engaging said peripheral surface, said doctor blade acting to limit the amount of liquid coating material applied onto said peripheral surface from said reservoir.

21. A sheet-fed, offset rotary printing press as set forth in claim 20 wherein said selectively operable means includes an extensible cylinder coupled between said reservoir and said press and operable to move said reservoir and said pick-up roller laterally between said first and second positions.

22. A sheet-fed, offset rotary printing press as set forth in claim 21 wherein said pick-up roller is rotatably driven by a motor attached to said coating apparatus.

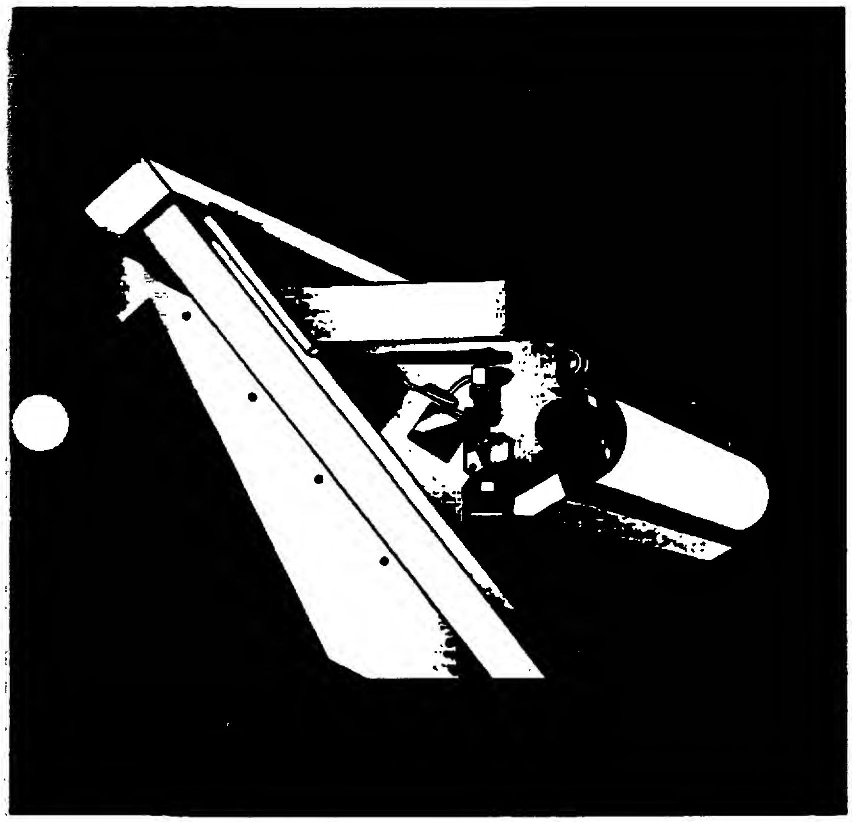
* * * * *

SUPER BLUE

PBC PLATE/BLANKET AND PC PLATE COATER

BECAUSE TO MOST CUSTOMERS HIGH GLOSS MEANS HIGH QUALITY

It is now possible to dramatically increase gloss levels of printed sheets



Among print buyers and consumers alike, "gloss" and "feel" are strongly associated with quality. Through our systems, printers can profitably achieve superb finish-quality and high-impact appearance at low cost.

Our Plate/Blanket Coater (PBC) maximizes your coating flexibility, giving you more precise control and broader capabilities than ever before. Offering full-coverage gloss or matte coatings as well as spot coatings of impeccable register and quality, the PBC smoothly and consistently applies uniform coatings of a wide viscosity range to any desired thickness.

- Precision spot-register applications
- Elimination of halos and hard/beaded edges
- Maximum coating application

The advent of coatable, water-based and UV-curable resins offers sheetfed color printers the unprecedented power to add high gloss levels, special effects and unusual surface treatments to their range of ***in-house*** capabilities. These coatings vastly exceed the gloss potential of varnish, while banishing forever the mess and quality problems spray powder causes in the pressroom.

Maximize pre[illegible] while minimi[illegible]

Because the PBC is easily retracted when coating is not necessary, the press unit used for coating can function as a full printing unit whenever you need it. Or, you can easily establish a dedicated coating line on an underused press. What's more, with our coaters, you will eliminate forever the press downtime associated with blanket cutting, packing and image registration. No other coater can accomplish this.

Our coaters minimize wash-up and makeready, offering unrivaled time and cost savings. Ruggedly constructed, easy to operate and maintain, our patented coaters are on the leading edge of industry technology.

Winner

GRAPHIC ARTS TECHNICAL FOUNDATION
GATF

InterTech Award

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- Makeready as fast as regular ink presses
- Elimination of slinging and misting problems
- Minimized wash-up times

The PBC provides unparalleled quality control, enabling you to coat with as much control as you print. Coating material is applied as if it were another ink color, using your printing unit as it was designed to operate — to lay down a precise film membrane on the substrate.

What's more, the PBC achieves this high-impact appearance in a fraction of the time it takes to varnish or laminate — and without the mess and quality control problems associated with these now obsolete methods. So your customers receive the highest quality product, with an incredibly fast turnaround.

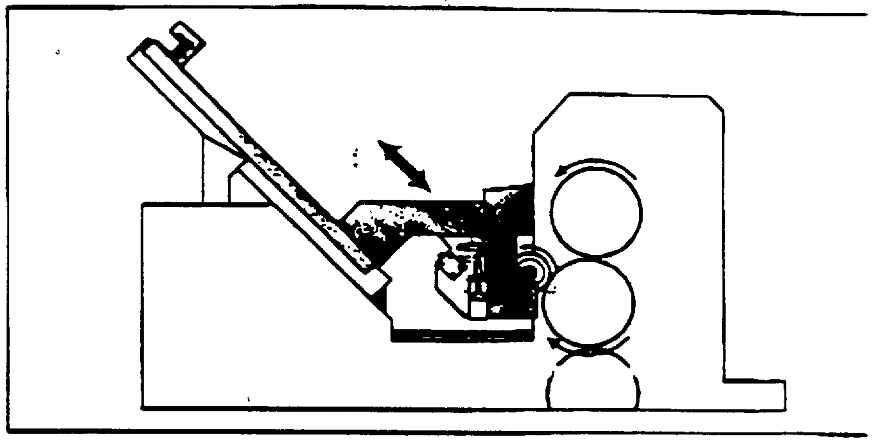
The PBC applies coating either at the blanket, for full coverage work, or at the plate, for precise register application of spot coating without hard edges. Or when coating is not necessary, it can be easily retracted to allow for regular printing uses. Unlike other coater designs that haphazardly squeeze coating material onto substrate under pressure — slinging coating material — the shear-coating PBC works neatly and precisely.

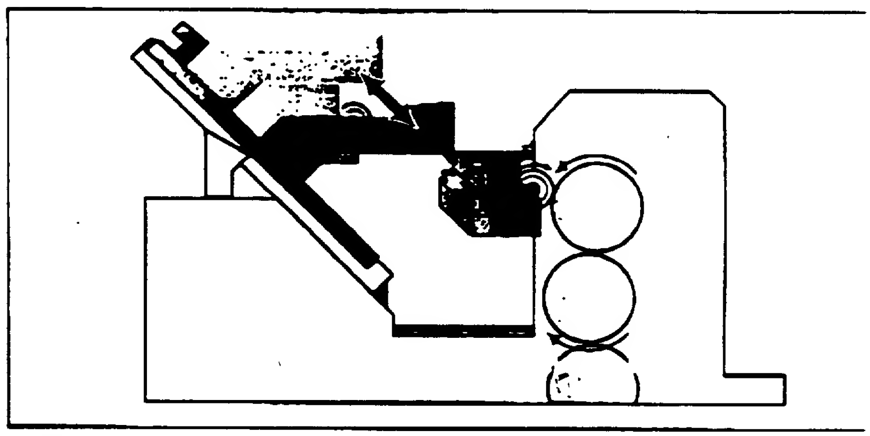
In the blanket mode when overall coverage is required, PBC's design provides for fast makeready and smooth application of the coating.

In the plate mode, the coater applies coating to a relief image on the plate cylinder to apply a uniform thickness of the coating film to the blanket cylinder. This coating "image" is then transferred by the blanket to the substrate, ensuring precise registration in all axes. Coating thickness and pressure between the plate, blanket and impression cylinders are all accurately and easily controlled.

Both the PBC and its Common Impression Cylinder (CIC) press counterpart, the Plate Coater (PC), improve operational profitability by eliminating the extensive "wash-up" downtime associated with coater dampeners — the only alternative with a CIC press. The typical two to three hour wash-up is reduced to less than a half hour, and the entire process is carried out independently from the press.

Being fully retractable, the coater does not interfere with the dampening system, ensuring fast changeover from print to coat and coat to print. This makes your entire operation more efficient *and* more profitable.



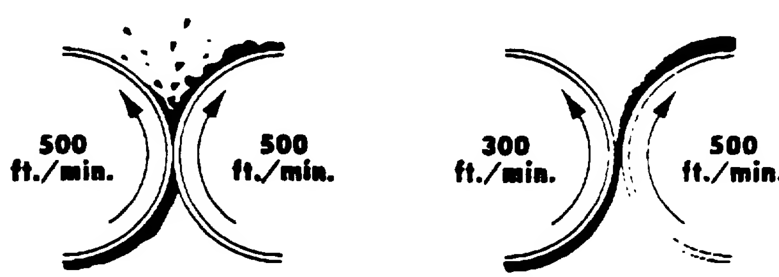


PBC in ... Position

Productivity, safety and long-term ...

As a supplier of precision-engineered coating and drying systems for the graphic arts and packaging industries, Printing Research, Inc.'s high-performance systems improve your bottom-line profitability by adding value to your existing operations. With our systems, you improve the quality of your services by becoming a low-cost provider of the highest quality printing — all while maximizing the utilization of your existing presses. Our dependable, high-performance systems will increase your sales, profits and customer satisfaction levels.

See the difference yourself. Experience a demonstration of our PBC and PC and witness how coatings can be as easy to handle and precise to apply as the ink used in daily printing!



NIP ... SHEAR

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Instant-drying inks and the elimination of spray powder have been the dream of every printer and printing buyer. The idea was put forward in the 1970's and 80's that it would be possible to print with conventional inks and apply a coating which would dry completely before placement on the delivery stack. This would place a dry skin over the ink, eliminating offsetting, sheet marking and the need for spray powder. The inks dry under the coating.

The advent of the 90's has made the dream a reality. It is now possible to print superior quality with conventional inks and coat the surface in order to deliver a dry, mark-free sheet at full production speeds. This is what the Super Blue products from Printing Research accomplish for you.

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10954 Shady Trail Dallas, Texas 75220 U.S.A
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Patented

11

US005176077A

United States Patent [19]

DeMoore et al.

[11] Patent Number: 5,176,077

[45] Date of Patent: Jan. 5, 1993

[54] COATING APPARATUS FOR SHEET-FED, OFFSET ROTARY PRINTING PRESSES

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[21] Appl. No.: 752,778

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[51] Int. Cl.[5] B41F 9/00

[52] U.S. Cl. 101/142; 101/147; 101/232; 101/348; 118/46

[58] Field of Search ..... 101/135, 424.1, 142, 101/148, 155, 157, 177, 217, 232, 246, 329, 330, 331, 408, 409, 419, 422, 348-349; 118/46, 211, 236, 249, 257, 258, 261, 262, 263, 206, DIG. 15

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4,402,267	9/1983	DeMoore	101/419
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4,704,296	11/1987	Leanna et al.	427/9
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2151185	7/1979	Fed. Rep. of Germany	101/424.2

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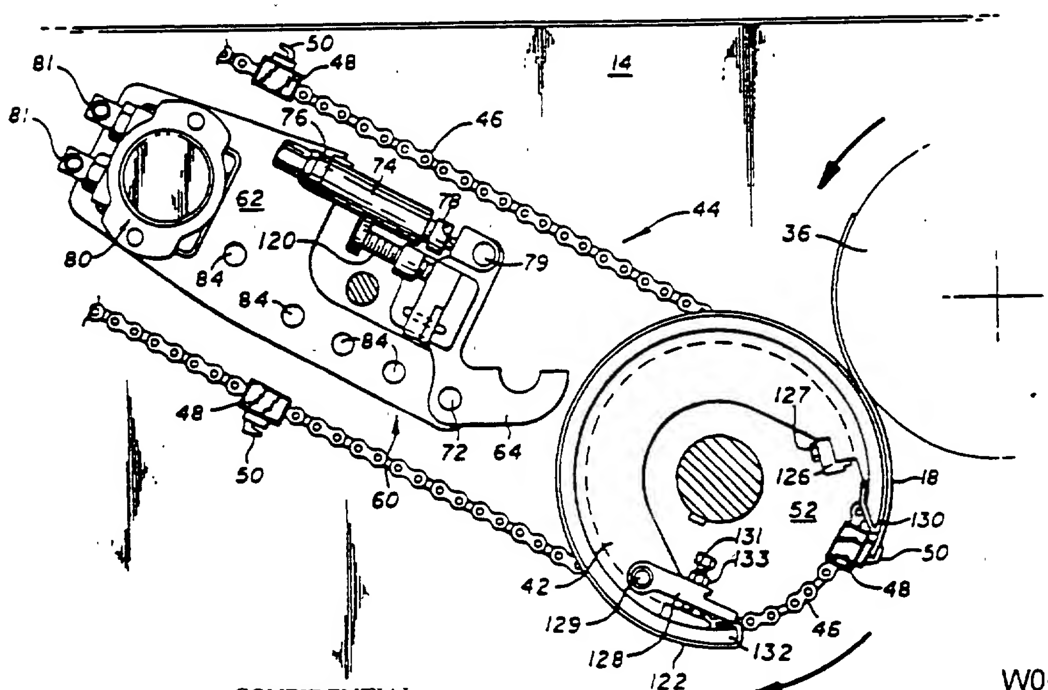
Attorney, Agent, or Firm—Dennis T. Griggs

[57] ABSTRACT

A coating apparatus for use in a sheet-fed, offset rotary printing press to selectively apply a protective and/or decorative coating to the wet ink surface of freshly printed sheets and including a coating unit having a pick-up roller for supplying aqueous coating material from a reservoir to the surface of a delivery cylinder mounted on a press delivery drive shaft, the delivery cylinder performing the dual function of a coating applicator roller and a delivery cylinder during coating operations.

22 Claims, 5 Drawing Sheets



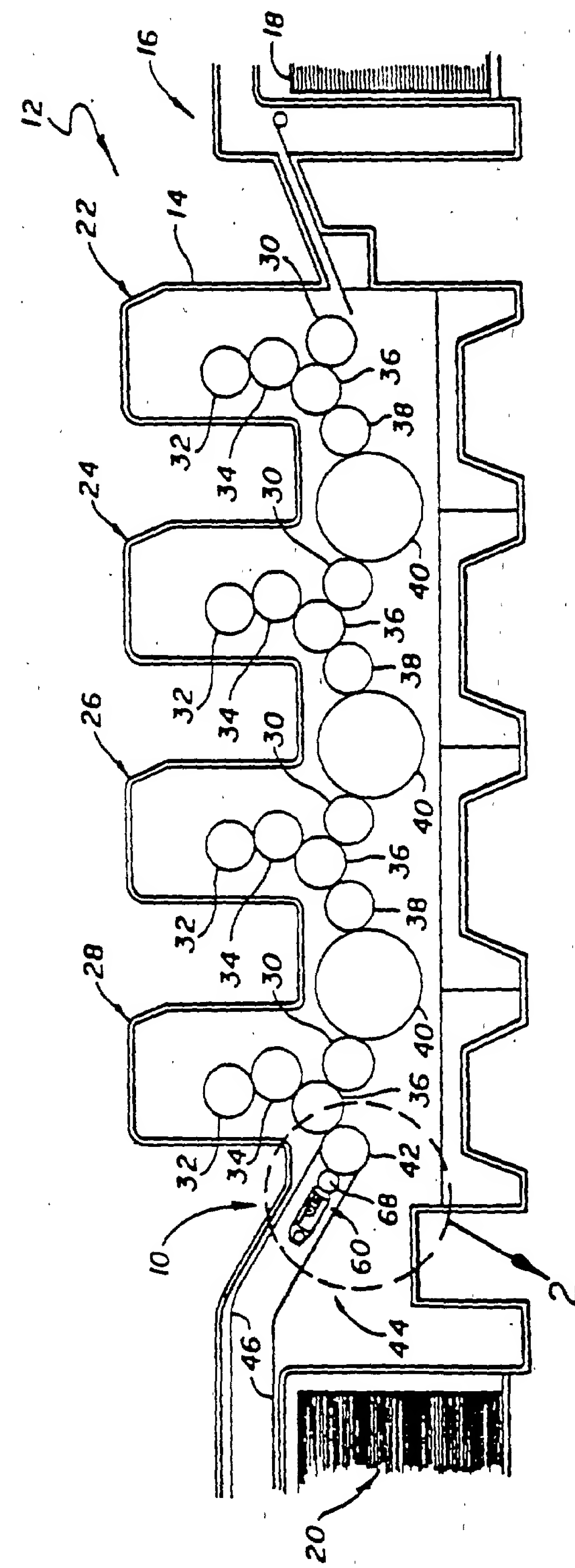


FIG. 1

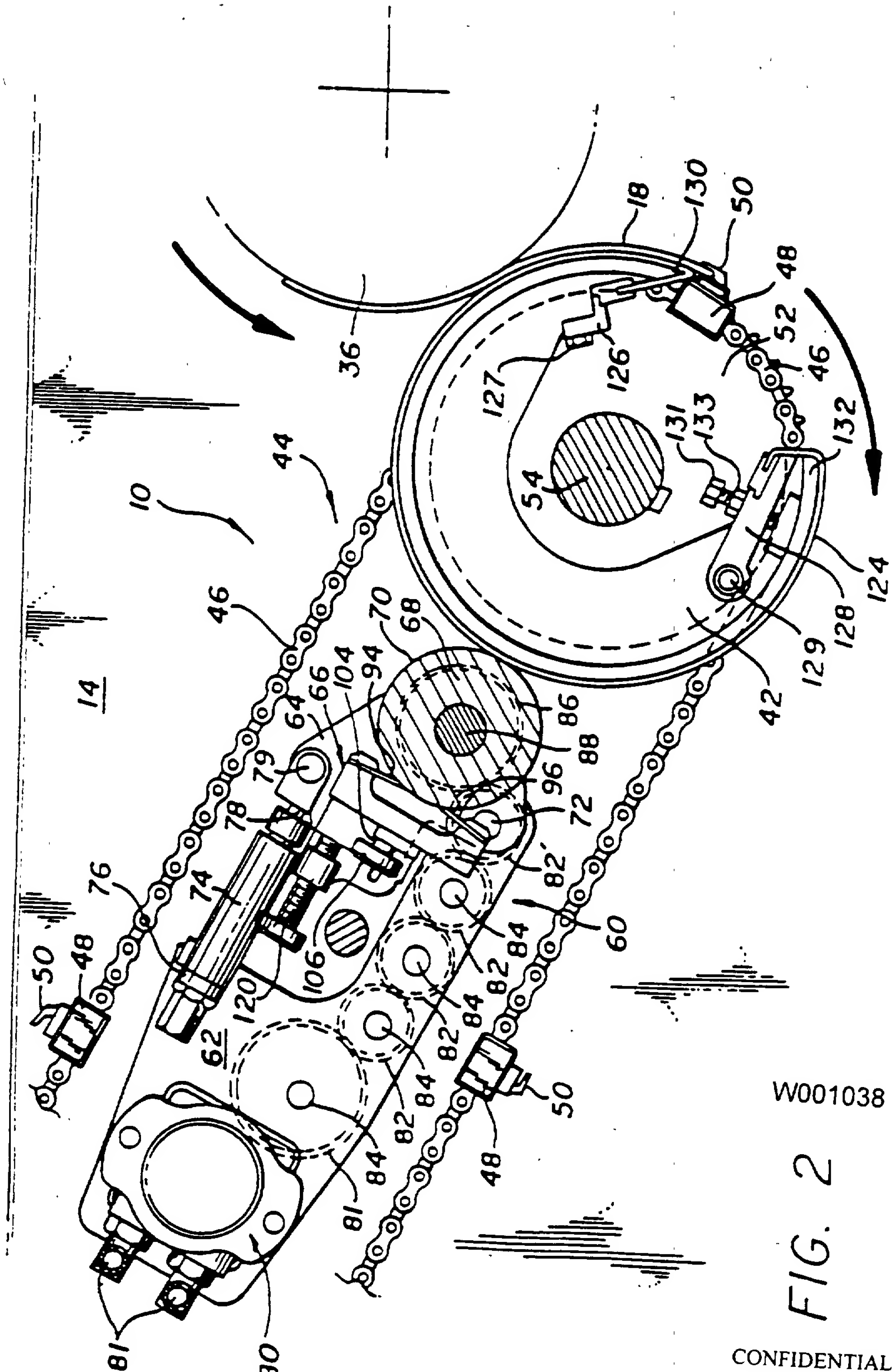


FIG. 2

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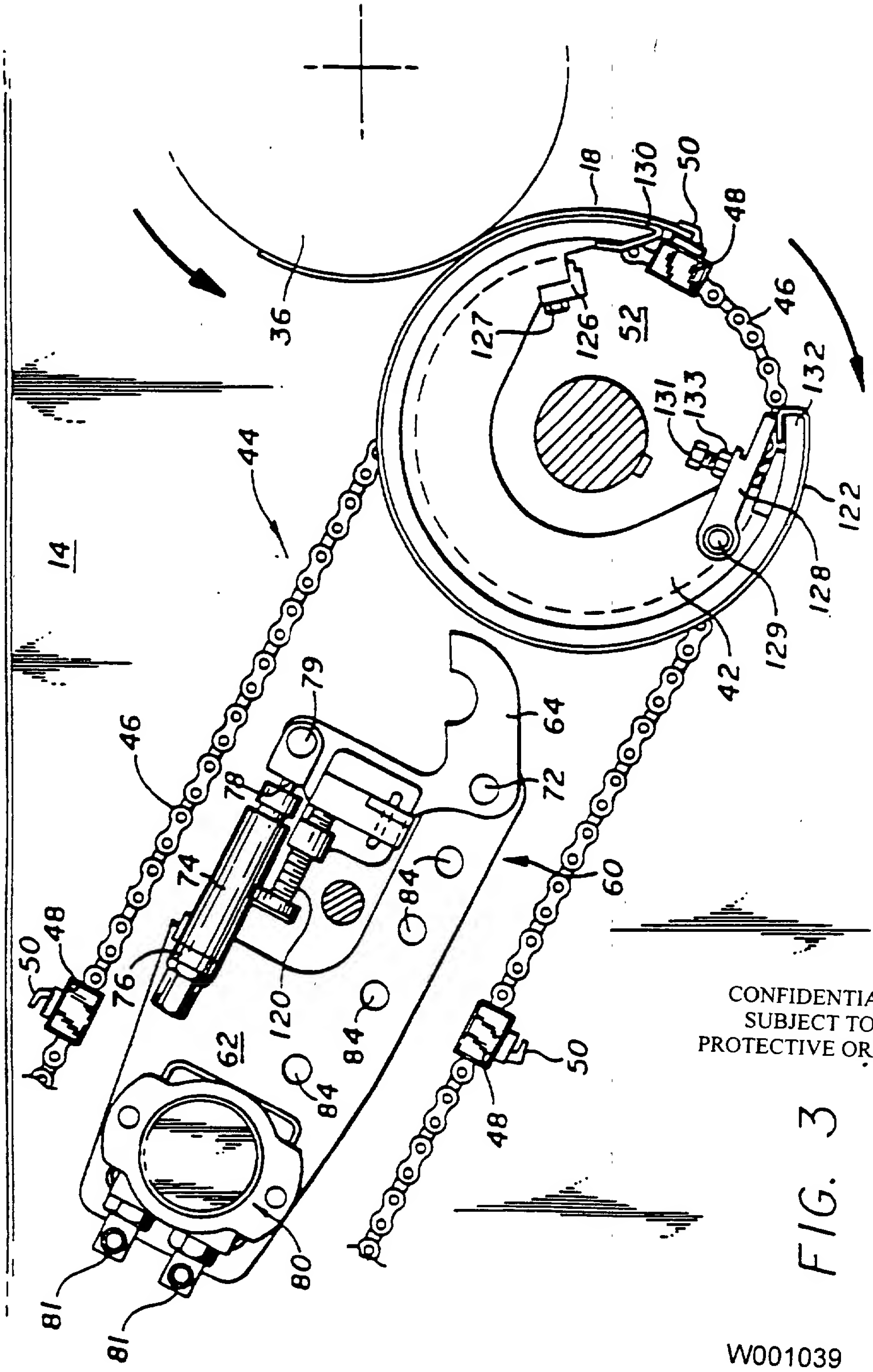
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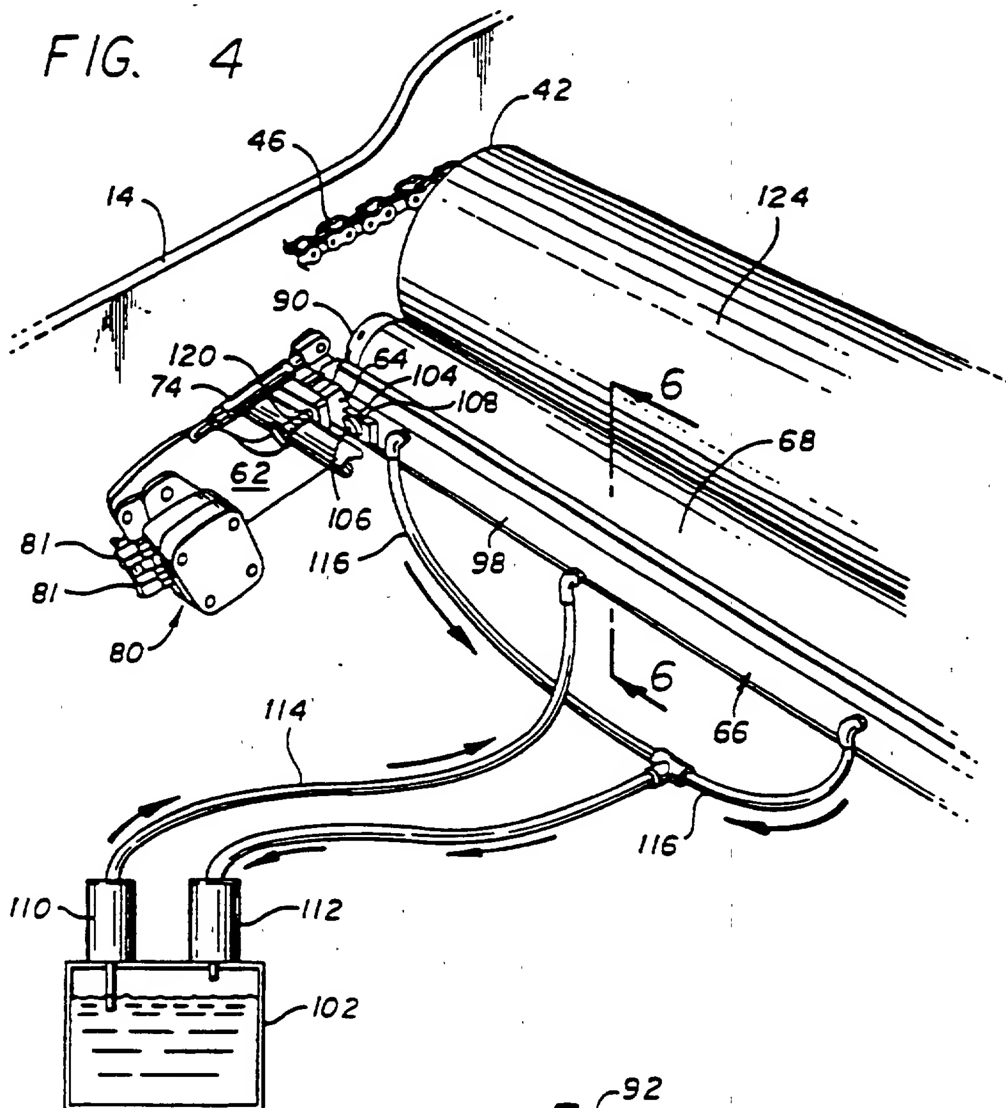
FIG. 3

FIG. 4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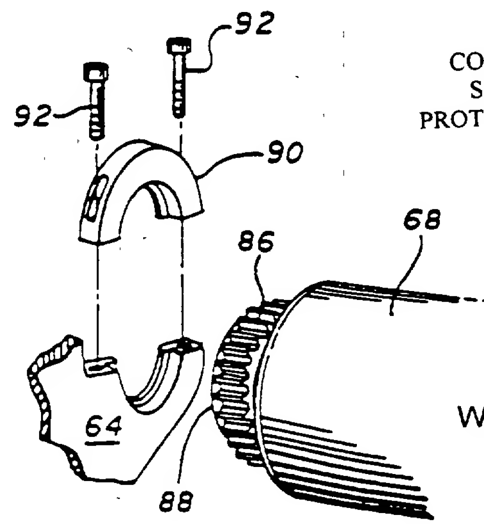
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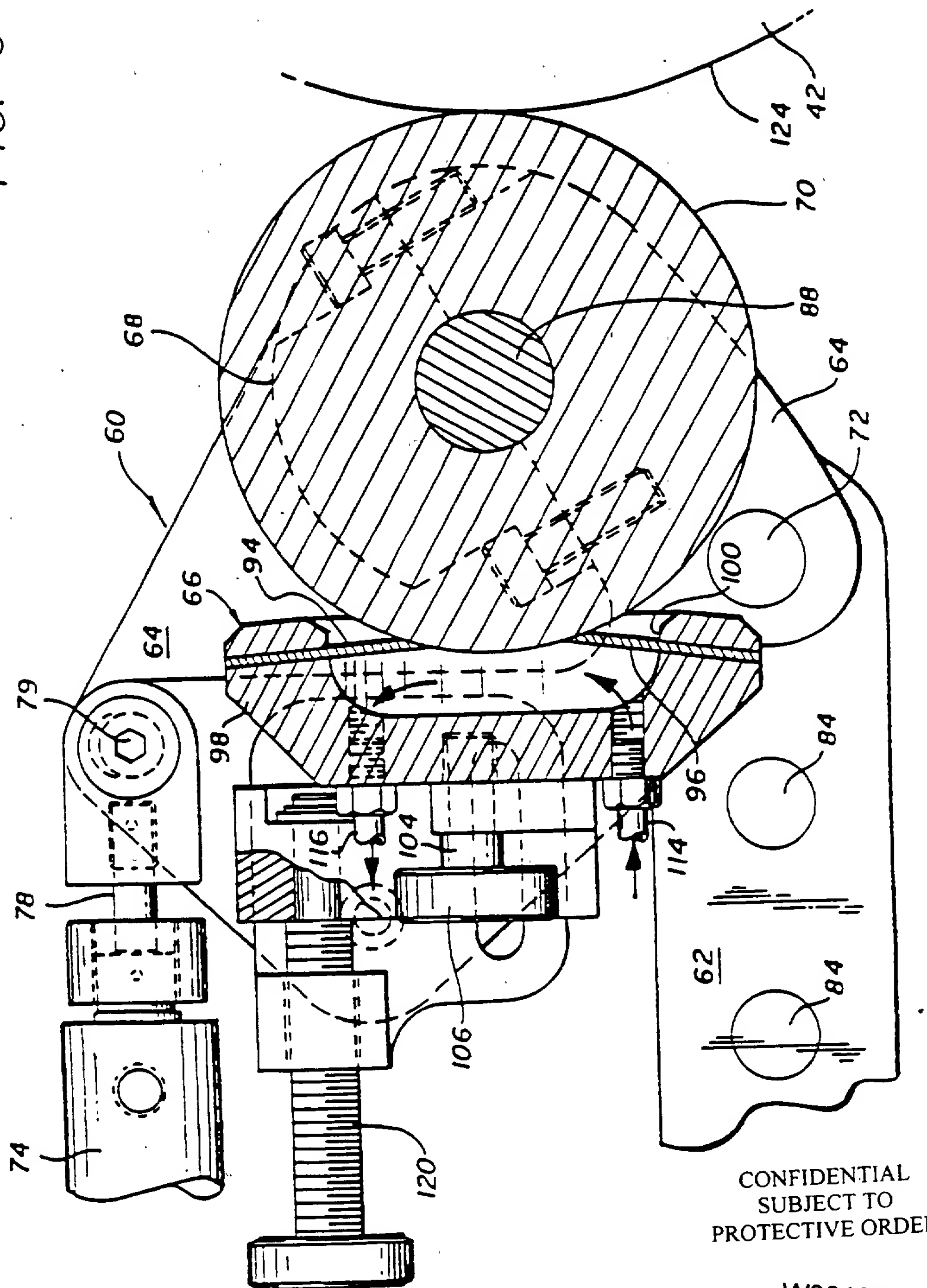
FIG. 5

FIG. 6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COATING APPARATUS FOR SHEET-FED, OFFSET ROTARY PRINTING PRESSES

BACKGROUND OF THE INVENTION

This invention relates to sheet-fed, offset rotary printing presses, and more particularly, to a new and improved apparatus for the in-line application of protective and decorative coatings to the printed surface of freshly printed sheets.

Conventional sheet-fed, offset rotary printing presses typically include one or more printing stations through which individual sheets are fed and printed with wet ink. After final printing, the sheets are fed by a delivery conveyor system to the delivery end of the press where the freshly printed sheets are collected and stacked. In a typical sheet-fed, offset rotary printing press such as the Heidelberg Speedmaster line of presses, the delivery conveyor system includes a pair of endless gripper chains carrying laterally spaced gripper bars and grippers which are used to grip and pull freshly printed sheets from the impression cylinder and convey the sheets toward the sheet delivery stacker. The gripper chains are driven in precisely timed relation to the impression cylinder by gripper chain sprocket wheels laterally spaced between a delivery drive shaft mounted on opposite sides of the press frame, the delivery drive shaft being mechanically coupled by gears for synchronous rotation with the impression cylinder.

Since the inks used with offset type printing presses typically remain wet and tacky for some time after printing, special precautions must be taken to insure that the wet inked surface of the freshly printed sheets are not marked or smeared as the sheets are transferred from one printing station to another, and through the delivery system to the sheet delivery stacker. One system for insuring that the freshly printed sheets are not marked or smeared during transfer is the transfer or delivery cylinder system marketed by Printing Research, Inc., of Dallas, Texas under its registered trademark "SUPER BLUE" That system, which is made and sold under license, is made in accordance with and operates as described in U.S. Pat. No. 4,402,267, issued Sep. 6, 1983 to Howard W. DeMoore, the disclosure of which is incorporated herein by this reference. In that system, marking and marring of freshly printed sheets is prevented by employing transfer or delivery cylinders provided with a coating of friction reducing material such as PTFE (Teflon) over which are loosely mounted fabric covers, referred to in the trade as "nets", and which support the wet ink side of the freshly printed sheets as they are pulled from the impression cylinder. Typically, in a multi-color press employing the "SUPER BLUE" cylinder system, each transfer cylinder for conveying the freshly printed sheets from one printing station to the next is supplied with a "SUPER BLUE" transfer cylinder system, and the delivery cylinder for conveying the sheets from the last printing station to the sheet delivery stacker is supplied with a "SUPER BLUE" delivery cylinder system. As used hereinafter, the term "net type cylinder" is intended to refer to cylinders having fabric nets disposed over the support surface, such as of the general type disclosed in the aforementioned DeMoore U.S. Pat. No. 4,402,267 and exemplified by the "SUPER BLUE" cylinder system.

Another system which can be used to prevent marking and smearing of the freshly printed sheets is that

disclosed in U.S. application Ser. No. 07/630,308 filed Dec. 18, 1990 entitled Vacuum Transfer Apparatus for Sheet-Fed Printing Presses now U.S. Pat. No. 5,127,329. That application, the disclosure of which is also incorporated herein by reference, discloses an apparatus which can be employed to draw the unprinted side of a freshly printed sheet into engagement with rollers which support the sheet on the unprinted side during transfer or delivery of the sheet from the impression cylinder after printing so that the wet ink on the freshly printed sheet does not come in contact with other apparatus in the press. The vacuum transfer apparatus disclosed in that application can be used as an alternative to the net type cylinder system disclosed in the aforementioned DeMoore patent, or when used in a perfecting press, as a supplement to that system, the vacuum transfer apparatus being primarily intended for use when only one-sided sheet printing is being performed by the press, and the net type cylinder system being used when the press is operating in the perfector mode with two-sided sheet printing.

In some printing applications, it is desirable that the press be capable of applying a protective and/or decorative coating over all or a portion of the surface of the printed sheets. Such coatings typically are formed of a UV-curable or water-soluble resin applied as a liquid solution or emulsion by an applicator roller over the freshly printed sheets to protect the ink and improve the appearance of the sheets. Use of such coatings is particularly desirable when decorative or protective finishes are required such as in the production of posters, record jackets, brochures, magazines, folding cartons and the like. In cases where a coating is to be applied, the coating operation is carried out after the final ink printing has been performed, most desirably by an in-line coating application, rather than as a separate step after the printed sheets have been delivered to the sheet delivery stacker.

Various suggestions have been made for applying the coating as an in-line press operation by using the final printing station of the press as the coating application station. For example, in U.S. Pat. Nos. 4,270,483, 4,685,414, and 4,779,557 there are disclosed coating apparatus which can be moved into position to allow the blanket cylinder of the last printing station of a press to be used to apply a coating material to the sheets. In U.S. Pat. No. 4,796,556 there is disclosed a coating apparatus which can be selectively moved between the blanket cylinder or the plate cylinder of the last printing station of the press so that that station can be used as a coating station for the press. However, when coating apparatus of these types are used, the last printing station can not be used to apply ink to the sheets, but rather can only be used for the coating operation. Thus, with these types of in-line press coating apparatus, the press loses the capability of printing its full range of colors since the last printing station is converted to a coating station.

Suggestions for overcoming the problem of the loss of a printing station when coating is desired have also been made, such as that set forth in U.S. Pat. Nos. 4,934,305 which discloses a coating apparatus having a separate timed applicator roller positioned to apply the coating material to the printed sheet while the sheet is on the last impression cylinder of the press. This is said to allow the last printing station to be operated simultaneously as both an ink application station and a coating

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station so that no loss of press printing unit capability results. Another approach to providing a coating station without loosing the printing capabilities of the last printing station is to provide a totally separate coating unit down stream of the last printing station so that the coating is applied to the sheets after final printing and before the sheets have reached the sheet delivery stacker. Such an approach is suggested in U.S. Pat. Nos. 4,399,767 and 4,706,601. While each of these suggestions provide coating stations which allow the final printing station to continue to be used for printing, they each suffer from the disadvantages of requiring the provision of separately driven coating applicator rollers and apparatus which must be precisely timed in relation to the movement of the sheet to be coated so as to insure precise registration between application of the coating material and the printed sheet. The provision of separate timed applicator rollers require that the presses be modified to provide sufficient space within the presses to accommodate the added coating apparatus or to increase the length of the presses, and require additional and complex drive connections with the press drive system to achieve the required precise speed correlation between the sheets and the applicator rollers. Such modifications can be both expensive and cumbersome to install and maintain.

Thus, there exists a need for a new and improved in-line apparatus for use in a sheet-fed, offset rotary printing press to selectively apply a protective and/or decorative coating to the printed surface of freshly printed sheets which allows the final press printing station to continue to be used as a printing station, yet which does not require any substantial press modification or the addition of a separate timed applicator roller. As will be explained in more detail hereinafter, the present invention solves this need in an novel and unobvious manner.

SUMMARY OF THE INVENTION

The present invention provides a new and improved in-line apparatus for selectively applying a protective and/or decorative coating to the surface of freshly printed sheets in a sheet-fed, offset rotary printing press which is highly reliable and effective in use, yet which does not require any expensive or substantial press modification or result in any impairment of normal press operating capability. The present invention enables the press to be used to selectively apply the coating material to the freshly printed sheets as the sheets are conveyed from the impression cylinder of the last printing station of the press toward the sheet delivery stacker by utilizing a delivery cylinder mounted to the existing press delivery drive shaft to perform the dual function of a coating material applicator roller and a sheet delivery cylinder so that no modification of the press is required to enable the press to be used for either coating or noncoating operation, and without impairment of any normal press operations.

More specifically, the present invention is intended for use in a sheet-fed, offset rotary printing press of the type having at least one printing station which includes a blanket cylinder and an impression cylinder disposed for printing ink onto sheets passing therebetween, and a delivery conveyor system for pulling freshly printed sheets off the impression cylinder and transporting the sheets toward the press sheet delivery stacker. For use of the present invention, the press must include a delivery drive shaft disposed adjacent to and extending parallel with the impression cylinder, and which is driven in timed synchronous relation with the impression cylinder.

In accordance with the invention, a delivery cylinder is mounted to the delivery drive shaft and provided with a coating blanket disposed over the peripheral outer surface of the cylinder, and adapted to engage and support the wet ink side of a freshly printed sheet. A coating apparatus including a supply of liquid coating material and a pick-up roller disposed to receive coating material from the supply, is mounted to the press and operable to permit the pick-up roller to be moved into engagement with the delivery cylinder so that coating material on the pick-up roller is transferred to the coating blanket of the delivery cylinder and then to the freshly printed sheet.

Preferably, the coating apparatus is mounted to the press downstream of the delivery drive shaft, and includes means to selectively move the pick-up roller into and out of engagement with the delivery cylinder. When the pick-up roller is not in the operable position in engagement with the delivery cylinder, the delivery cylinder can be used for conventional noncoating sheet delivery by removing the coating blanket and, preferably, replacing the coating blanket with a fabric net such as of the net type cylinder system previously described. To convert to a coating operation, the coating blanket is attached to the delivery cylinder and, depending upon the thickness of the sheets to be printed, packed with suitable packing sheets to increase the effective diameter of the cylinder so that pressure is applied to the freshly printed sheets against the impression cylinder by the coating blanket covered delivery cylinder. The pick-up roller is then moved to the operative position engaged with the delivery cylinder so that as freshly printed sheets are pulled by the delivery conveyor from the impression cylinder around the delivery cylinder, coating material applied to the delivery cylinder by the pick-up roller is transferred to the freshly printed sheets in the nip between the delivery cylinder and the impression cylinder.

Since the delivery cylinder is driven by the delivery drive shaft in precise timed relation with the impression cylinder, exact registration between the application of coating material and the printed sheet is assured. Further, since the coating of the freshly printed sheets is carried out through use of a delivery cylinder mounted to the existing press delivery drive shaft, no substantial press modifications are required, and the press can be quickly and easily converted between coating and noncoating operation with no loss of printing capability of the final printing station.

Many other features and advantages of the present invention will become more apparent from the following detailed description take in conjunction with the accompanying drawings which disclose, by way of example, the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic side elevational view of a sheet-fed, offset rotary printing press having a coating apparatus embodying the present invention;

FIG. 2 is an enlarged fragmentary side elevational view taken substantially within the circular area designated "2" in FIG. 1 and showing the coating apparatus of the present invention during coating operation,

FIG. 3 is a side elevational view similar to FIG. 2, but showing the coating apparatus in the inoperative posi-

tion with the coating pick-up roller and reservoir removed, and the blanket covering over the delivery cylinder replaced with a fabric net for non-coating printing;

FIG. 4 is an enlarged fragmentary perspective view showing one side of the coating apparatus mounted in the press and illustrating the fluid path of coating material from a supply tank to the reservoir of the coating unit;

FIG. 5 is an enlarged fragmentary perspective view illustrating the end mounting of the coating pick-up roller to its support bracket; and

FIG. 6 is an enlarged fragmentary sectional view taken substantially along the lines 6—6 of FIG. 4

DETAILED DESCRIPTION OF PRESENTLY PREFERRED EMBODIMENT

As shown in the exemplary drawings, the present invention is embodied in a new and improved in-line apparatus, herein generally designated 10, for selective use in applying a protective and/or decorative coating to the freshly printed surface of sheets printed in a sheet-fed, offset rotary printing press, herein generally designated 12. In this instance, as shown in FIG. 1, the coating apparatus 10 is illustrated as installed in a four color printing press 12, such as that manufactured by Heidelberger Druckmaschinen AG of the Federal Republic of Germany under its designation "Heidelberg Speedmaster 102V (40")," and which includes a press frame 14 coupled at one end, herein the right end, with a sheet feeder 16 from which sheets, herein designated 18, are individually and sequentially fed into the press, and at the opposite end, with a sheet delivery stacker 20 in which the finally printed sheets are collected and stacked. Interposed between the sheet feeder 16 and the sheet delivery stacker 20 are four substantially identical sheet printing stations 22, 24, 26 and 28 which can print different color inks onto the sheets as they are moved through the press 10.

As illustrated, each of the printing stations 22, 24, 26 and 28 is substantially identical and of conventional design, herein including a sheet feed cylinder 30, a plate cylinder 32, a blanket cylinder 34 and an impression cylinder 36, with each of the first three printing stations 22, 24, and 26 having a transfer cylinder 38 disposed to withdraw the freshly printed sheets from the adjacent impression cylinder and transfer the freshly printed sheets to the next printing station via a transfer drum 40. The final printing station 28 herein is shown as equipped with a delivery cylinder 42 which functions to support the printed sheet 18 as it is moved from the final impression cylinder 36 by a delivery conveyor system, generally designated 44, to the sheet delivery stacker 20.

The delivery conveyor system 44 herein is of conventional design and includes a pair of endless delivery gripper chains 46, only one of which is shown in the drawings, carrying at regular spaced locations along the chains, laterally disposed gripper bars 48 having gripper elements 50 used to grip the leading edge of a sheet 18 after it leaves the nip between the delivery cylinder 42 and impression cylinder 36 of the last printing station 28. As the leading edge of the sheet 18 is gripped by the grippers 50, the delivery chains 46 pull the sheet away from the impression cylinder 36 and convey the freshly printed sheet to the sheet delivery stacker 20 where the grippers release the finally printed sheet. The endless delivery chains 46 are driven in synchronous timed relation to the impression cylinder 36 by sprocket wheels 52 fixed adjacent the lateral ends of a delivery drive shaft 54 which has a mechanically geared coupling (not shown) through the press drive system to the impression cylinder. The delivery drive shaft 54 extends laterally between the sides of the press frame 14 adjacent the impression cylinder 36 of the last printing station 28, and is disposed to be parallel with the axis of the impression cylinder. In this instance, the delivery cylinder 42, which is constructed to allow adjustments in diameter by suitable means, is fixedly mounted to the delivery drive shaft 54 so that the delivery cylinder is also rotated in precise timed relation to the impression cylinder.

Preferably, each of the transfer cylinders 38 is equipped with an anti-marking system such as the aforementioned net type transfer cylinder system or the press 12 can be supplied in the transfer positions with vacuum transfer systems of the type disclosed in the above-identified copending U.S. application Ser. No. 07/630,308 filed Dec. 18, 1990, although as will become more apparent hereinafter, the use of such transfer systems is not required for the present invention and other types of transfer systems can be used. For reasons that will become more apparent hereinafter, for most effective use of the present invention, however, the delivery cylinder 42 should be of the type which employs the "SUPER BLUE" delivery cylinder system, or, as an alternative, should employ in the delivery position, a vacuum transfer system such as disclosed in the above-identified copending U.S. application Ser. No. 07/630,308.

In this respect, it is important to note that when the freshly printed sheets 18 are conveyed away from the impression cylinder 36 of the final printing station 28 by the gripper 50 carried by the delivery chains 46, the wet inked surfaces of the sheets face the delivery drive shaft 54 and the sheets must be supported such that the ink is not marked or smeared as the sheets are transferred. Typically, such support is provided by skeleton wheels or cylinders mounted to the press delivery drive shaft 54, or as is now more commonly used, net type delivery cylinders such as of the "SUPER BLUE" delivery cylinder system type disclosed in the aforementioned DeMoore patent. More recently, vacuum transfer apparatus of the type disclosed in the aforementioned copending U.S. application Ser. No. 07/630,308 have been used in place of delivery cylinders or skeleton wheels to pull the unprinted side of the sheet away from the delivery drive shaft 54 so that the wet ink surface of the sheets do not come into contact with any press apparatus. It has been found, however, that when a protective or decorative coating material is applied to the wet ink surface of the sheets, the coating protects the wet ink against marking and smearing such that the coating applicator roller itself can be used to support the wet inked surface of the sheets without fear of damage to the freshly printed surface.

In accordance with the present invention, the in-line coating apparatus 10 for selectively applying the protective or decorative coating to the sheets 18 enables the press 12 to be operated in the normal manner without the loss of the final printing station 28, and without requiring any substantial press modifications by employing the existing press delivery drive shaft 54 as the mounting location for the coating applicator roller. In presses 12 utilizing a net type delivery cylinder system, that system can be quickly and easily converted to perform the dual function of being a coating applicator roller and a delivery cylinder. In presses having other

types of delivery systems such as skeleton wheels mounted on the delivery drive shaft 54 or a vacuum transfer apparatus as disclosed in the aforementioned copending U.S. application Ser. No 07/630,308, conversion to a coating operation can be quickly and easily achieved by mounting on the press delivery drive shaft in place of the skeleton wheels or in addition to the vacuum transfer apparatus, a suitable support cylinder capable of performing the combined function of a coating applicator roller and a delivery cylinder 42. Typically, such a support cylinder will have a diameter which provides no more than about a 0.090 inch clearance between the cylinder support surface and the adjacent impression cylinder 36. By utilizing the delivery cylinder 42 mounted on the delivery drive shaft 54 to also act as a coating applicator roller, the present invention insures that the coating will be applied to the printed sheet 18 in precise timed registration, and will permit the press to be operated with its full range of printing stations, yet allow fast, simple and convenient change-over from coating to noncoating operations, and vice versa, with a minimum of press down time.

Toward these ends, the coating apparatus 10 of the present invention includes a relatively simple, positive acting and economical coating unit, generally designated 60, mounted to the press frame 14 down stream of the delivery drive shaft 54 and positioned to selectively supply coating material to the support surface of a delivery cylinder 42 mounted on the delivery drive shaft. As best can be seen in FIGS. 2, 4 and 6, the coating unit 60 herein comprises a pair of side frames 62, only one of which is shown, it being understood that the other side frame is substantially the same as that of the side frame illustrated, attached to each side of the press frame 14. Pivotally mounted to one end of each of the side frames 62 is a support bracket 64 carrying one end of a coating material reservoir 66 and cooperating coating material pick-up roller 68 each disposed to extend laterally across the press 12 parallel with the delivery drive shaft 54. The coating unit 60 is mounted between the upper and lower runs of the delivery chains 46 down stream of the delivery drive shaft 54, and positioned so that the outer peripheral surface 70 of the pick-up roller 68 can be frictionally engaged with the support surface of a delivery cylinder 42 mounted on the delivery drive shaft.

As best seen in FIGS. 2 through 4, the support bracket 64 is pivotally attached to the end of the side frame 62 by a shaft 72 disposed at the lower end portion of the bracket, and can be pivoted about the shaft by an extensible cylinder 74, herein shown as a hydraulic cylinder, one end 76 of which is secured such as by welding to the side frame, and the opposite end 78 of which is coupled through a pivot shaft 79 to the upper end portion of the bracket. By extending or retracting the cylinder 74, the extent of frictional engagement of the pick-up roller 68 with the surface of the delivery cylinder 42 can be controlled, and the pick-up roller can be completely disengaged from the delivery cylinder.

The coating pick-up roller 68, which can be of conventional design and preferably one such as the Anilox roller manufactured by A.R.C. International of Charlotte, N.C., and sold under the name "PRINTMASTER" having an engraved ceramic or chrome outer peripheral surface 70, is designed to pick up a predetermined uniform thickness of coating material from the reservoir 66, and then uniformly transfer the coating to the support surface of the delivery cylinder 42. To effect rotation of the pick-up roller 68, a suitable motor 80, herein a hydraulic motor, is attached to one of the side frames 62 and coupled to a suitable hydraulic fluid source (not shown) through fittings 81. Attached to the output of the motor 80 is an output gear which is drivingly coupled through a reduction gear 81 and a series of idler gears 82 each mounted on stub axles 84, to a drive gear 86 attached to the end of a shaft 88 on which the pick-up roller 68 is concentrically mounted. The shaft 88 of the pick-up roller 68 is, in turn, journaled at each end to the brackets 64 through a releasable semicircular collar 90 (see FIG. 5) attached by bolts 92 to the bracket. Herein, the axle of the terminal idler gear, designated 82', also serves as the shaft 72 for pivotally mounting the support bracket 64 to the side frame 62 so that when the bracket is rotated about the shaft, the terminal idler gear remains engaged with the drive gear 86 of the pick-up roller 68.

In this instance, as best as can be seen in FIG. 6, the pick-up roller 68 has a portion which projects laterally into the reservoir 66 containing the supply of coating material, and a pair of upper and lower inclined doctor blades 94 and 96 attached to the reservoir engage the roller surface to meter the coating material picked up from the reservoir by the etched surface 70 of the roller. The reservoir 66 herein is formed by an elongated, generally rectangular housing 98 having a generally C-shaped cross-section with a laterally extending opening 100 along one side facing the pick-up roller 68, and is supplied with coating material from a supply tank 102 disposed in a remote location within or near the press 12. Preferably, the reservoir 66 is removably attached to the brackets 64, herein by bolts 104 having enlarged, knurled heads 106, and which can be threaded through slots 108 formed in the brackets to clamp the reservoir in place on the brackets.

To insure that an adequate supply of coating material is always present within the reservoir 66 and to prevent coagulation and clogging of the doctor blades 94 and 96 by the aqueous coating material, the coating material is circulated through the reservoir, herein by two substantially identical pumps 110 and 112, one of which pumps coating material from the supply tank 102 via a supply line 114 to the bottom of the reservoir, and the other of which acts to provide suction to a pair of return lines 116 coupled adjacent the top of the reservoir for withdrawing unused coating material from the reservoir. By circulating the coating material from the supply tank 102 at a greater rate than the rate of withdrawal of material by the pick-up roller 68, a substantially constant supply of coating material will always be present within the reservoir 66.

In this instance, the general arrangement of the pick-up roller 68, doctor blades 94 and 96, and reservoir 66 is substantially like that disclosed in U.S. Pat. No. 4,821,672 entitled DOCTOR BLADE ASSEMBLY WITH ROTARY END SEALS AND INTERCHANGEABLE HEADS", the disclosure of which can be reviewed for details concerning the structure and operation of a pick-up roller and reservoir usable with the present invention.

Once the coating unit 60 has been installed in a press 12, which basically only requires that the side frames 62 be attached, such as with bolts, to the sides of the press frame 14, and the hydraulic motor 80 be coupled with a suitable hydraulic source, the press can be quickly and easily converted to the coating mode. In presses 12 already supplied with a net type delivery cylinder sys-

tem, to convert to a coating operation, all that is necessary is that the fabric net material (designated 122 in FIG. 3) normally used over the support surface of the net type delivery cylinder during noncoating press operations, be removed and replaced with a coating blanket 124 capable of transferring coating material deposited thereon onto the printed sheets. Typically, such a blanket 124 can be formed as a rubber covering such as used for the covering surface of the conventional blanket cylinders 34 of the press 12. In presses 12 having conventional skeleton wheels or a vacuum transfer type apparatus such as that of the aforementioned copending U.S. application Ser. No. 07/630,308, a suitable delivery cylinder 42 can be fixed to the delivery drive shaft 54 and a similar coating blanket 124 applied thereto over the cylinder surface.

It is important to note that during nonprinting operations, the net type delivery cylinder 42 does not engage the surface of the impression cylinder 36 during sheet delivery. However, when used as a coating applicator roller during coating operations, the effective diameter of the delivery cylinder 42 must be increased so that the coating blanket 124 presses the sheet 18 against the surface of the impression cylinder 36, as shown in FIG. 2. To increase the effective diameter of the delivery cylinder 42, the thickness of the coating blanket 124 applied over the support surface of the delivery cylinder 42 can be selected to correspond with the thickness of the sheets 18 to be printed, or suitable packing sheets, such as paper sheets (not shown) of the type conventionally used in conjunction with press blanket cylinders 34, can be interposed between the delivery cylinder and the coating blanket.

While any suitable means can be used to attached the coating blanket 124 to the support surface of the delivery cylinder 42, in this instance, as shown in FIGS. 2 and 3, the delivery cylinder is supplied with clamps 126 attached by bolts 127 to the cylinder adjacent the leading edge 130 to secure the leading edge of the coating blanket 124 to the cylinder, and adjustable tensioning clamps 128 are provided adjacent the cylinder trailing edge 132 for securing the trailing edge of the blanket to the cylinder. However, the tensioning clamps 128 are pivotally mounted at one end by a pin 129 to the cylinder 42, and the blanket tension is adjusted through a bolt 131 and nut 133 arrangement. Depending upon the thickness of the sheets 18 to be printed and coated by the press 12, one or more layers of packing paper or the like may be interposed between the support surface of the delivery cylinder 42 and the coating blanket 124 to increase the effective diameter of the cylinder. Provision of the tensioning clamps 128 for attaching the coating blanket 124 to the leading edge 132 of the delivery cylinder 42 allows for such control and adjustment.

Once installed, the coating unit 60 can remain in position even though the press 12 is operated in the non-coating mode. In this respect, when the coating unit 60 is not in operation, the extensible cylinder 74 can be actuated to pivot the support brackets 64 carrying the pick-up roller 68 and reservoir 66 about the shaft 72 and away from the delivery cylinder 42, thus rendering the coating unit inoperative. This then also frees the pick-up roller 68 and reservoir 66 for fast and easy removal from the coating unit 60 for cleaning, service or replacement. To remove the pick-up roller 68, the coating material is drained from the reservoir 66, and the pressure exerted by the doctor blades 94 and 96 against the roller is released, therein through operation of a pressure adjustment screw 120 attached to the reservoir, and the bolts 92 and collars 90 are removed, thereby permitting the pick-up roller to be lifted from the coating unit 60. To remove the reservoir 66, all that need be done is to release the mounting bolts 104 securing the reservoir to the brackets 64. With the coating unit 60 moved by the extensible cylinder 74 to the inoperative position, the delivery cylinder 42 can be converted for normal delivery cylinder operation simply by removing the coating blanket 124 from the delivery cylinder 42 and replacing the blanket with a fabric net 122. Alternatively, if a vacuum transfer apparatus such as described in the aforementioned copending U.S. application Ser. No. 07/630,308 is installed in the press 12, that apparatus can be activated to deliver sheets from the impression cylinder 36 without effecting any delivery cylinder change since the freshly printed side of the sheets will not come into contact with the delivery cylinder.

In a typical noncoating operation of the press 12 with the coating apparatus 10 installed, the coating unit 60 will be in the inoperative position. In that situation and with a net type delivery cylinder 42 installed, the delivery cylinder will be covered with the fabric net 122 so that the delivery cylinder operates in the normal manner with the wet ink side of the freshly printed sheets 18 being supported by the net covered surface of the delivery cylinder. Should the press 12 include a vacuum transfer apparatus such as disclosed in the aforementioned copending U.S. application Ser. No. 07/630,308, the delivery cylinder 42 can remain on the delivery drive shaft 54, with or without a fabric net 122, depending upon whether or not the press is used for perfector printing.

When it is desired to convert to the coating mode of operation, the press 12 is stopped just long enough to replace the fabric net 122 on the delivery cylinder 42 with the coating blanket 124 packed to the required extent necessary for providing the proper pressure to effect coating of the sheet thickness to be printed. Thereafter, the pumps 110 and 112 are activated and the press 12 re-started. The extensible cylinder 74 can then be activated to control the pressure of the pick-up roller 68 against the delivery cylinder 42 to obtain the desired application of coating material to the freshly printed sheets 18.

Notably, with the coating apparatus 10 of the present invention, no timing adjustments between the delivery cylinder 42 and the impression cylinder 36 are required to achieve and maintain precise registration between application of the coating material and the printed surface of the sheets 18. Further, the coating unit 60 permits a wide range of coating weights to be applied to the printed sheets 18 by quickly and easily changing pick-up rollers 68 from those designed to produce a very light coating application to those designed to produce a very thick coating application can be used.

From the foregoing, it should be apparent that the coating apparatus 10 of the present invention provides a highly reliable, effective and economical in-line apparatus for selectively applying coating material to the freshly printed sheets 18 in a sheet-fed, offset rotary printing press 12 which allows the final printing station to continue to be used as a print station, yet which does not require any substantial press modification or the addition of a separate timed applicator roller. While a particular form of the present invention has been illustrated and described, it should be apparent that varia-

tions and modifications therein can be made without departing from the spirit and scope of the invention.

We claim:

1. In a sheet-fed, offset rotary printing press of the type including at least one printing station having a blanket cylinder and an impression cylinder disposed for printing ink onto sheets passing therebetween, and a delivery conveyor system for pulling freshly printed sheets from the impression cylinder and transporting the printed sheets toward a sheet delivery stacker, the delivery conveyor system including a delivery drive shaft disposed adjacent to and extending parallel with the impression cylinder and driven in timed synchronous relation with the impression cylinder, the improvement comprising:

a delivery cylinder mounted to said delivery drive shaft and having an outer peripheral support surface adapted to engage and support a sheet being transported by said delivery conveyor system;

a coating apparatus including a supply of liquid coating material, a rotatable pick-up roller having an outer peripheral surface of substantially cylindrical shape, and means for applying a coating of liquid coating material from said supply onto said outer peripheral surface of said pick-up roller; and

means for mounting said coating apparatus to the press adjacent said delivery cylinder including selectively operable means for moving said pick-up roller between a first operable position with a portion of said peripheral surface of said pick-up roller engaged with said support surface of said delivery cylinder, and a second inoperable position with said peripheral surface out of engagement with said support surface of said delivery cylinder, whereby when said pick-up roller is in said first operable position, liquid coating material from said supply applied onto said peripheral surface of said pick-up roller is transferred to said support surface of said delivery cylinder and to said freshly printed sheet.

2. The improvement as set forth in claim 1 wherein said delivery cylinder includes a coating blanket disposed over said peripheral support surface.

3. The improvement as set forth in claim 1 wherein said delivery cylinder includes a removable coating blanket disposed over said peripheral support surface when said pick-up roller is in said first operable position.

4. The improvement as set forth in claim 3 wherein said coating blanket has a rubber outer surface.

5. The improvement as set forth in claim 3 wherein said delivery cylinder includes a fabric net disposed over said peripheral support surface when said pick-up roller is in said second inoperable position.

6. The improvement as set forth in claim 1 wherein said coating apparatus includes an elongated reservoir containing said supply of liquid coating material, said reservoir being disposed to extend parallel with said pick-up roller with a portion of said peripheral surface extending into said reservoir in contact with liquid coating material contained therein, and at least one doctor blade attached to said reservoir and engaging said peripheral surface, said doctor blade acting to limit the amount of liquid coating material applied onto said peripheral surface from said reservoir.

7. The improvement as set forth in claim 6 wherein said reservoir and said pick-up roller are movably coupled to said press and said selectively operable means includes an extensible cylinder coupled between said reservoir and said press and operable to move said reservoir and said pick-up roller between said first and second positions.

8. The improvement as set forth in claim 7 wherein said pick-up roller is rotatably driven by a motor attached to said coating apparatus.

9. The improvement as set forth in claim 8 wherein said delivery cylinder includes a rubber coating blanket disposed over said peripheral support surface when said pick-up roller is in said first operable position, and includes a fabric net disposed over said peripheral support surface when said pick-up roller is in said second inoperable position.

10. The improvement as set forth in claim 9 wherein said coating apparatus is mounted to said press downstream of said delivery drive shaft in the direction of travel of said sheets during transport by said delivery conveyor system.

11. The improvement as set forth in claim 1 wherein said mounting means includes first and second side frames mounted on said press, a support shaft mounted on and extending between said first and second side frames, a support bracket attached to said coating apparatus and movably coupled to said support shaft for pivotal movement between said first and second positions, and said selectively operable means includes an extensible cylinder coupled between said coating apparatus and said support bracket and operable to move said coating apparatus toward and away from said delivery cylinder.

12. In a sheet-fed, offset rotary printing press of the type including at least one printing station having a blanket cylinder and an impression cylinder disposed for printing wet ink onto sheets passing therebetween, and a delivery conveyor system for pulling freshly printed sheets from the impression cylinder and transporting the printed sheets toward a sheet delivery stacker, the delivery conveyor system comprising a pair of endless gripper chains disposed on opposite sides of the press and supporting therebetween gripper bars and grippers spaced along the chains, the gripper chains being driven in timed synchronous relation with the impression cylinder by laterally spaced sprocket wheels mounted on opposite ends of a delivery drive shaft disposed adjacent to and extending parallel with the impression cylinder, the improvement comprising:

a delivery cylinder mounted to said delivery drive shaft between said sprocket wheels and having an outer peripheral support surface covered by a removable coating blanket adapted to engage and support the wet ink side of a sheet being transported by said gripper bars;

a coating apparatus including a supply of liquid coating material, a rotatable pick-up roller having an outer peripheral surface of substantially cylindrical shape communicating with said supply, and means for applying liquid coating material from said supply onto said peripheral surface of said pick-up roller; and,

means for mounting said coating apparatus to the press adjacent the delivery cylinder, said means including selectively operable means for moving said coating apparatus between a first operable position with a portion of said peripheral surface of said pick-up roller engaged with said delivery cylinder, and a second inoperable position with said peripheral surface of said pick-up roller out of engagement with said delivery cylinder, whereby when said coating apparatus is in said first operable

position, liquid coating material from said supply metered onto said peripheral surface of said pick-up roller is transferred to said delivery cylinder and to said freshly printed sheet, and when said coating apparatus is in said second inoperable position, said delivery cylinder is disposed for non-coating sheet delivery operation.

13. The improvement as set forth in claim 12 wherein the effective diameter of said delivery cylinder covered by said coating blanket is sufficient to apply pressure to sheets against said impression cylinder as said sheets are pulled from said impression cylinder by said gripper bars.

14. The improvement as set forth in claim 13 wherein said coating blanket has a rubber outer support surface.

15. The improvement as set forth in claim 14 wherein said coating apparatus is disposed downstream of said delivery drive shaft in the direction of travel of said sheets during transport by said delivery conveyor system.

16. A sheet-fed, offset rotary printing press including:

at least one printing station having a blanket cylinder and an impression cylinder disposed for printing wet ink onto sheets passing therebetween,

a delivery conveyor system for pulling freshly printed sheets from the impression cylinder and transporting the printed sheets toward a sheet delivery stacker, the delivery system including a delivery drive shaft;

a delivery cylinder mounted to said delivery drive shaft and having an outer peripheral support surface adapted to engage and support a sheet being transported by said delivery conveyor system,

a coating apparatus including a supply of liquid coating material, a rotatable pick-up roller having an outer peripheral surface of substantially cylindrical shape communicating with said supply, and means for applying liquid coating material from said supply onto said peripheral surface of said pick-up roller, and

means for mounting said coating apparatus to the press adjacent said delivery cylinder, said means including selectively operable means for moving said pick-up roller between a first operable position with a portion of said peripheral surface of said pick-up roller engaged with said delivery cylinder, and a second inoperable position with said peripheral surface of said pick-up roller out of engagement with said delivery cylinder, whereby when said pick-up roller is in said first operable position, liquid coating material from said supply applied to said peripheral surface of said pick-up roller is transferred to said delivery cylinder and then to said freshly printed sheet.

17. A sheet-fed, offset rotary printing press as set forth in claim 16 wherein said delivery cylinder includes a removable coating blanket disposed over said peripheral support surface when said pick-up roller is in said first operable position.

18. A sheet-fed, offset rotary printing press as set forth in claim 17 wherein said coating blanket has a rubber outer surface.

19. A sheet-fed, offset rotary printing press as set forth in claim 17 wherein said delivery cylinder includes a fabric net disposed over said peripheral support surface when said pick-up roller is in said second inoperable position.

20. A sheet-fed, offset rotary printing press as set forth in claim 19 wherein said coating apparatus includes an elongated reservoir containing said supply of liquid coating material, said reservoir being disposed to extend parallel with said pick-up roller with a portion of said peripheral surface extending into said reservoir in contact with liquid coating material contained therein, and at least one doctor blade attached to said reservoir and engaging said peripheral surface, said doctor blade acting to limit the amount of liquid coating material applied onto said peripheral surface from said reservoir.

21. A sheet-fed, offset rotary printing press as set forth in claim 20 wherein said selectively operable means includes an extensible cylinder coupled between said reservoir and said press and operable to move said reservoir and said pick-up roller laterally between said first and second positions.

22. A sheet-fed, offset rotary printing press as set forth in claim 21 wherein said pick-up roller is rotatably driven by a motor attached to said coating apparatus.

* * * * *

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United States Patent [19]

DeMoore et al.

[11] Patent Number: 5,207,159

[45] Date of Patent: May 4, 1993

[54] COATING APPARATUS FOR SHEET-FED, OFFSET ROTARY PRINTING PRESSES

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[73] Assignee: Howard W. DeMoore, Plano, Tex.

[21] Appl. No.: 879,841

[22] Filed: May 6, 1992

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 752,778, Aug. 30, 1991.

[51] Int. Cl.[5] B41F 31/00

[52] U.S. Cl. 101/350; 101/351; 101/367; 101/147; 118/261; 118/262

[58] Field of Search 101/135, 147, 148, 157, 101/167, 169, 207, 208, 210, 329, 330, 331, 348, 349, 350, 351, 364, 365, 366, 367; 118/602, 612, 236, 242, 259, 261

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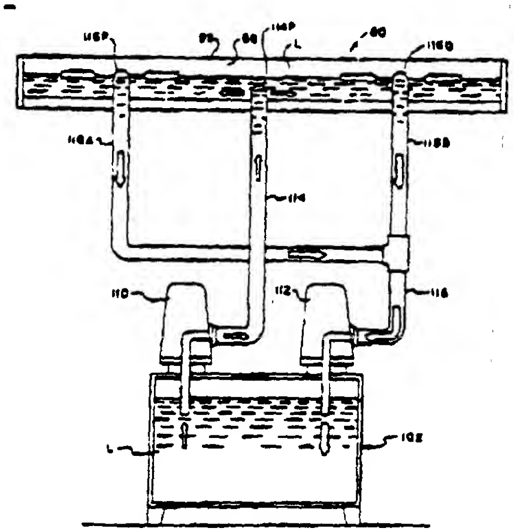
Primary Examiner—Eugene H. Eickholt
Attorney, Agent, or Firm—Dennis T. Griggs

[57] ABSTRACT

A coating apparatus for use in a sheet-fed or web-fed, offset rotary or flexographic printing press to apply a protective and/or decorative coating to the surface or freshly printed sheets includes a doctor blade coating unit coupled to a pickup roller for supplying liquid material from a reservoir to the surface of a pickup roller mounted on a press delivery drive shaft. Liquid material is circulated through the reservoir of the doctor blade unit by suction flow produced by a return pump. This prevents the buildup of a positive pressure differential within the doctor blade reservoir. The doctor blade reservoir is maintained at below ambient pressure level, thereby preventing leakage through the end seals. A vacuum sensor circuit provides a visual indication of air vacuum pressure in the doctor blade reservoir chamber, and a vacuum sensor switch applies electrical power to an audio transducer. The audio transducer produces an audible alarm in response to an increase in doctor blade chamber pressure, thereby providing advance warning of an impending end seal failure or a worn doctor blade condition.

21 Claims, 9 Drawing Sheets



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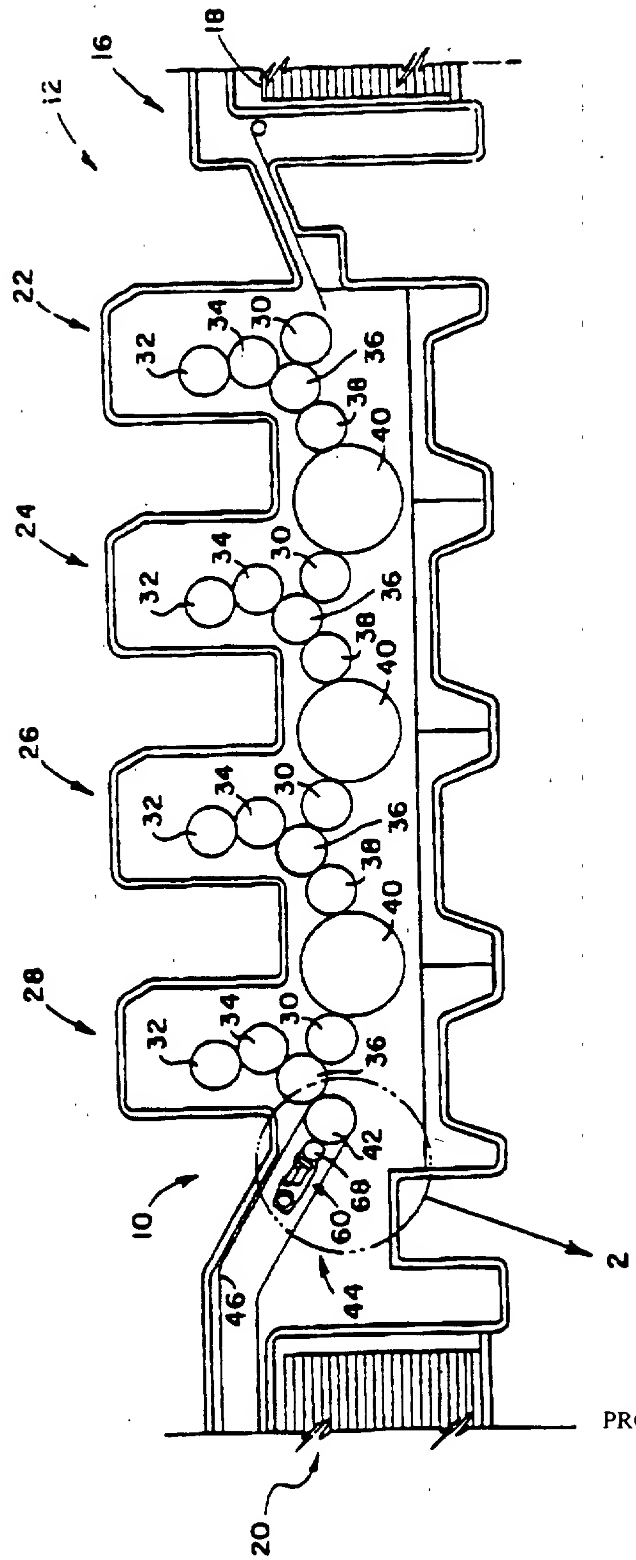

FIG. 1

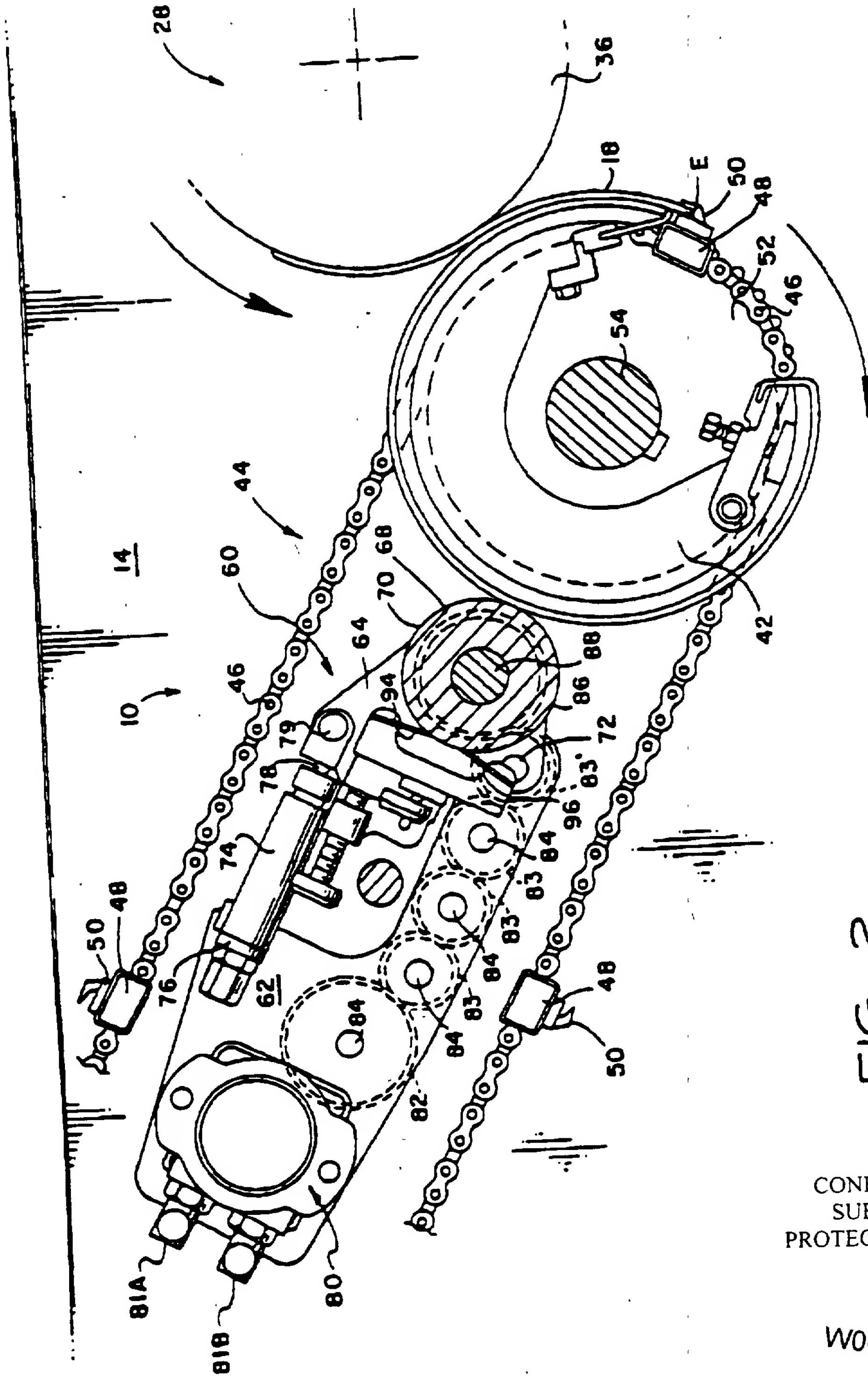

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FIG. 2

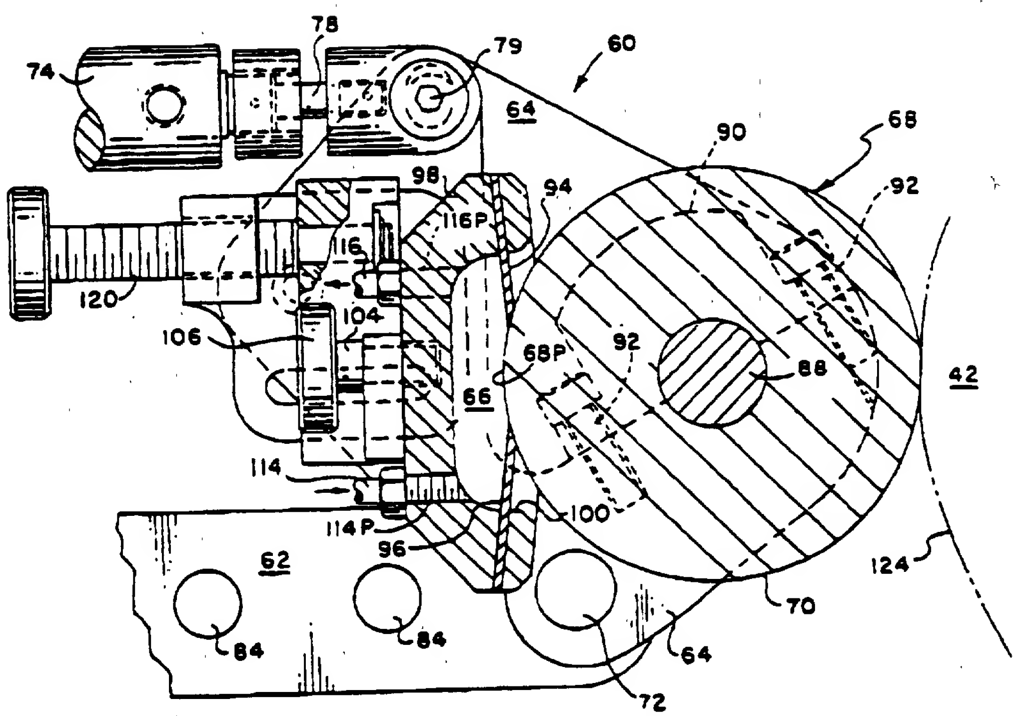
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FIG. 4

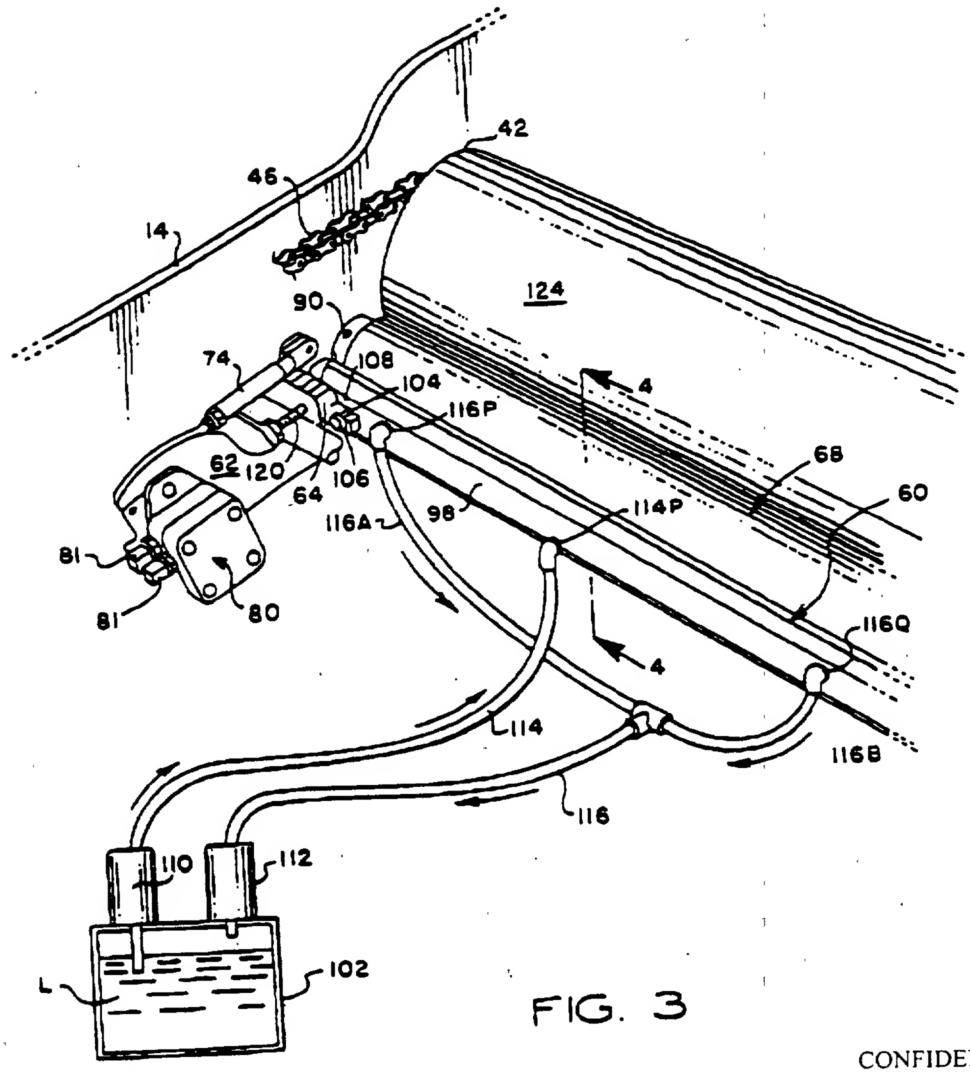

FIG. 3

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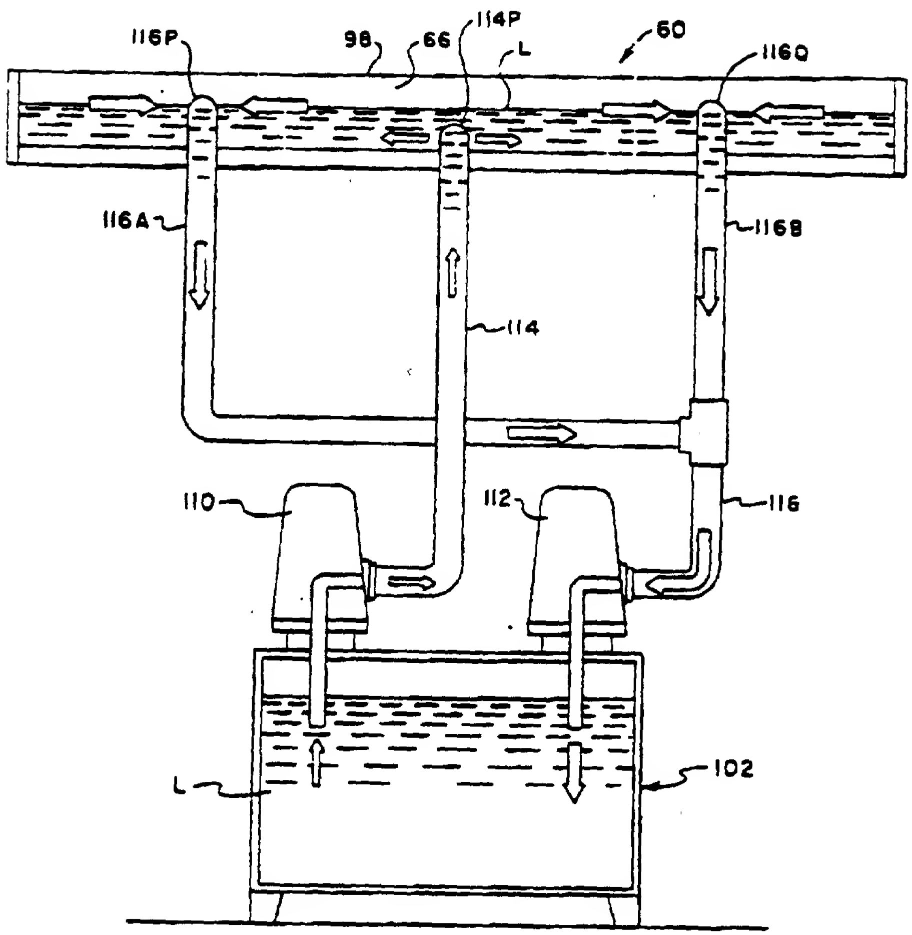

FIG. 5

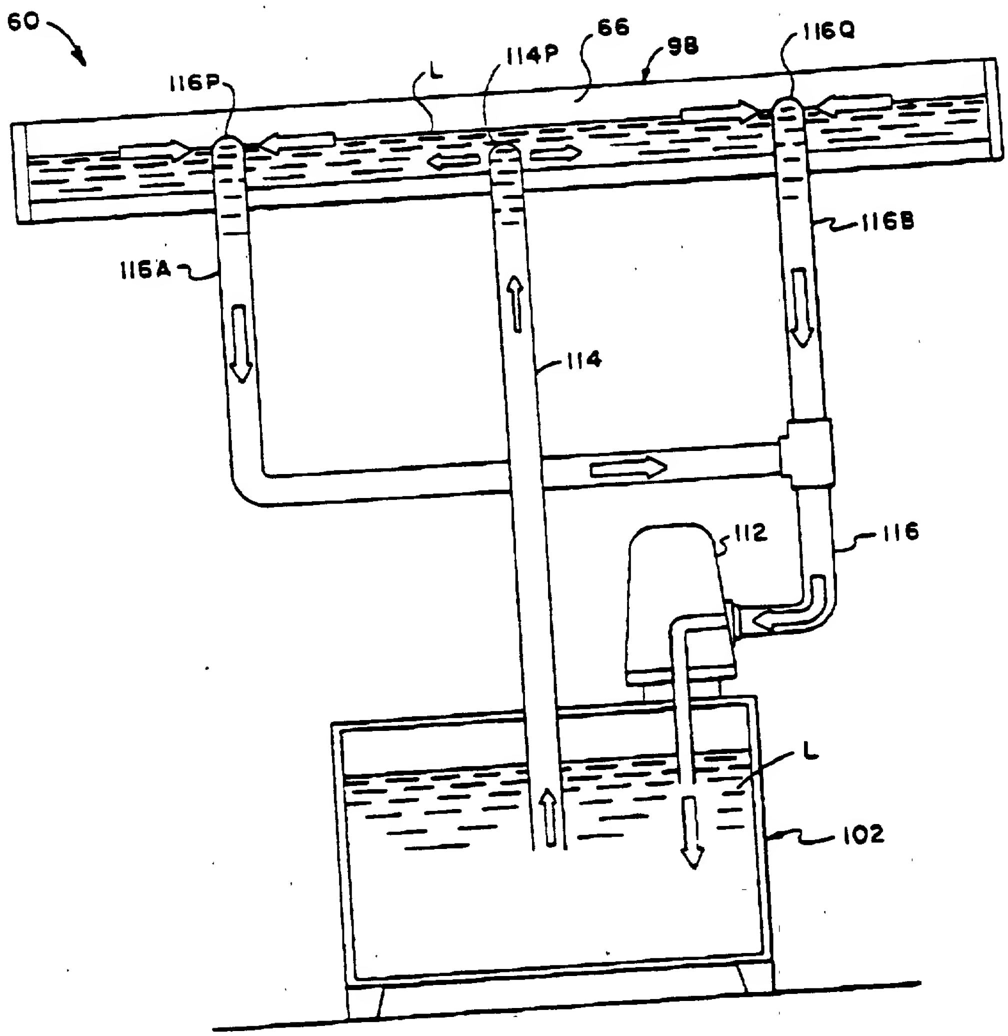

FIG. 6

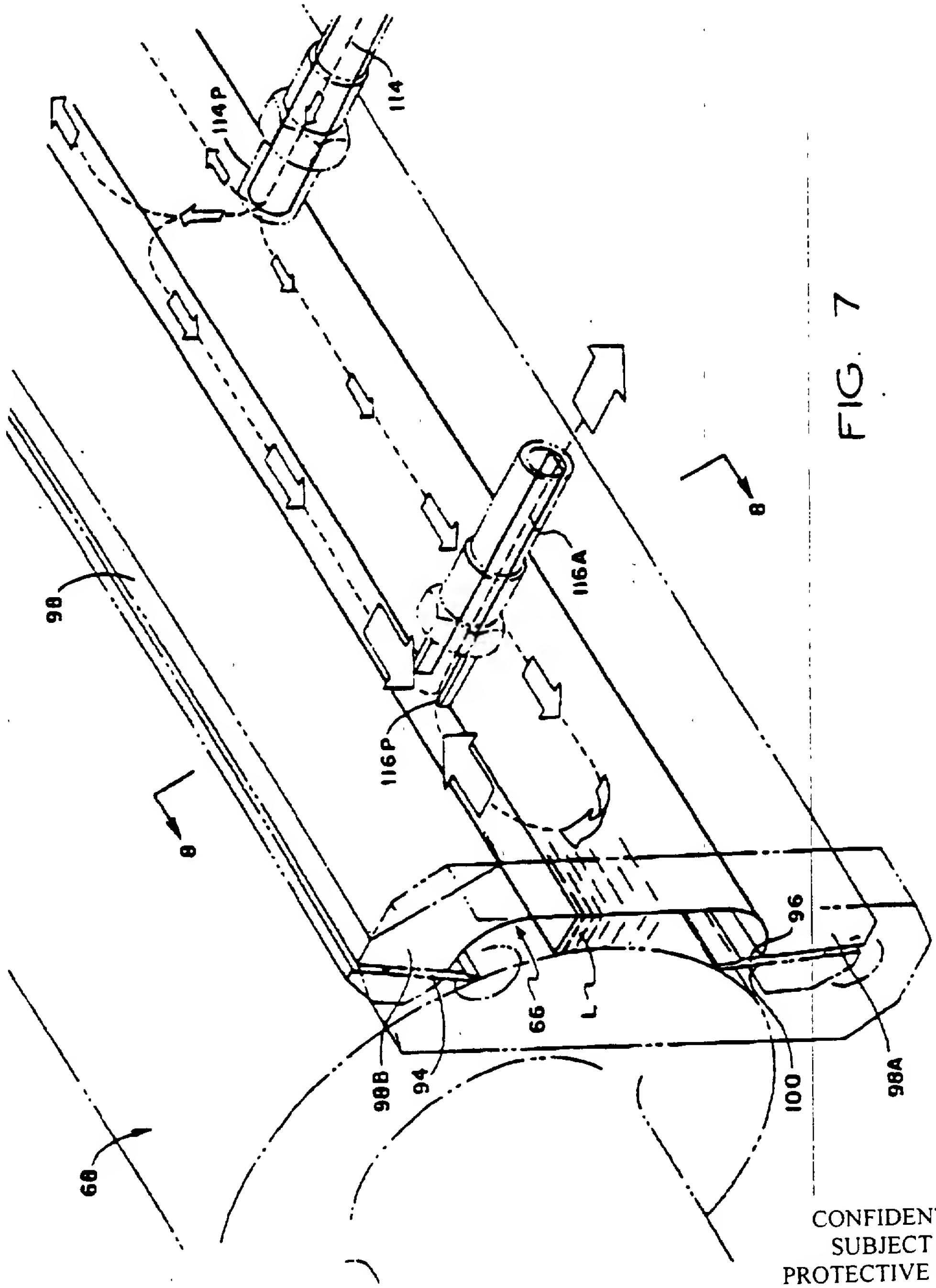

FIG. 7

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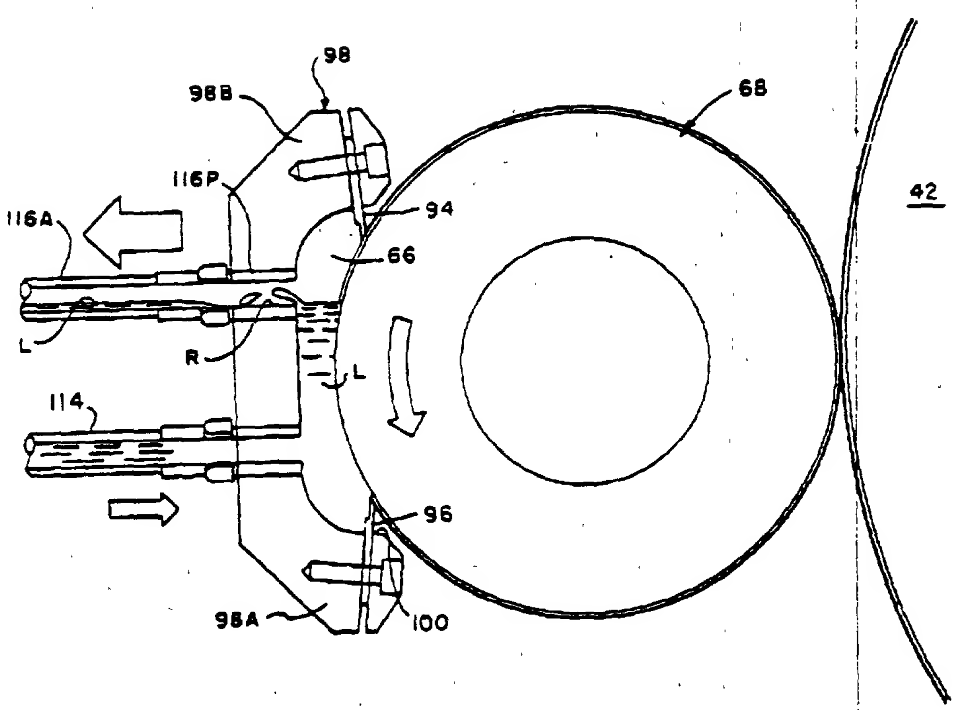

FIG. 8

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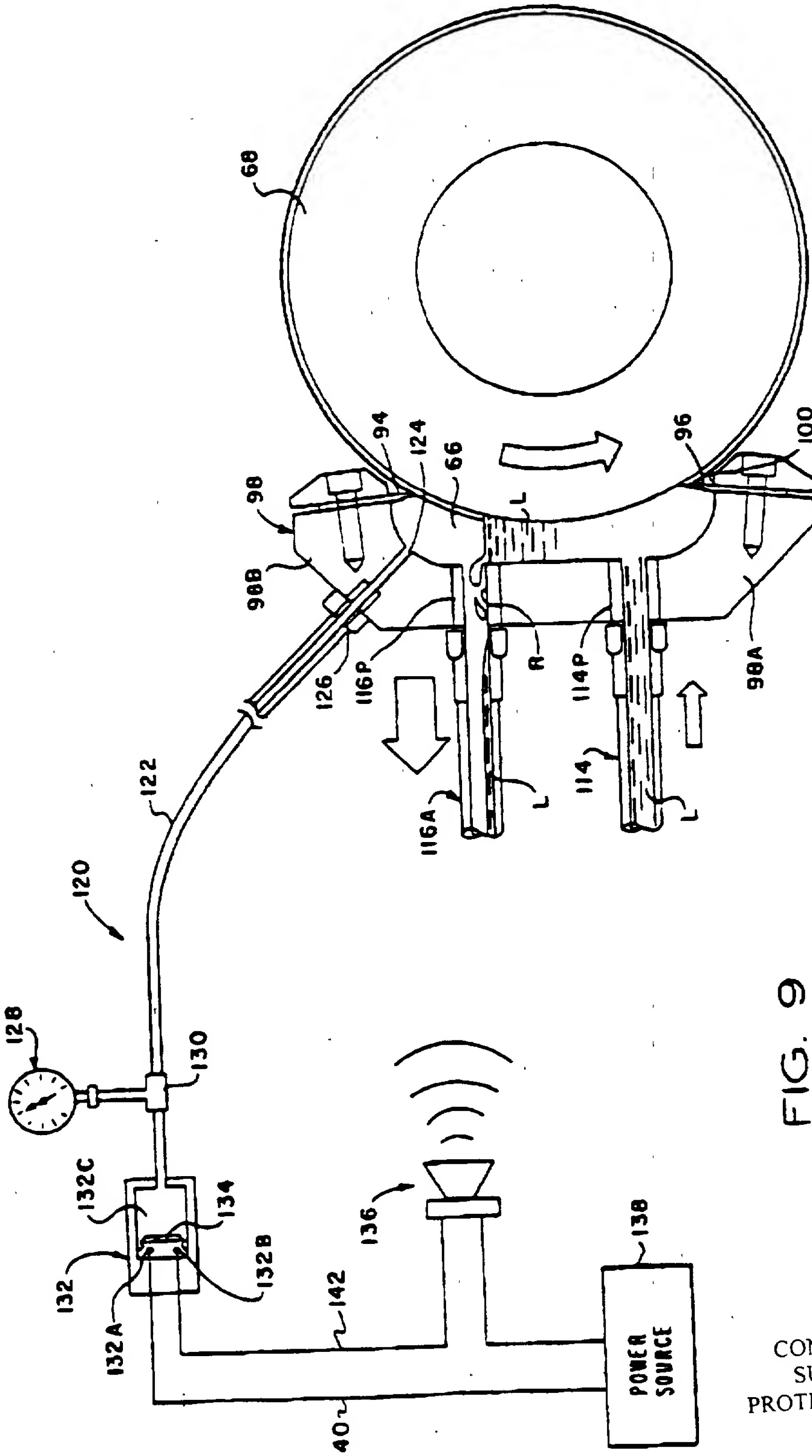
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114P
98A
114
116A
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132C
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132B
132
132A
142
136
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POWER SOURCE
140

FIG. 9

COATING APPARATUS FOR SHEET-FED, OFFSET ROTARY PRINTING PRESSES

CROSS REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part of application Ser. No. 07/752,778 filed Aug. 30, 1991.

FIELD OF THE INVENTION

This invention relates to sheet-fed or web-fed, offset rotary or flexographic printing presses, and more particularly, to a new and improved apparatus for the in-line application of protective and decorative coatings or inks to the printed surface of freshly printed sheets or web.

BACKGROUND OF THE INVENTION

Conventional sheet-fed, offset rotary printing presses typically include one or more printing stations through which individual sheets are fed and printed with wet ink. After final printing, the sheets are fed by a delivery conveyor system to the delivery end of the press where the freshly printed sheets are collected and stacked. In a typical sheet-fed, offset rotary printing press such as the Heidelberg Speedmaster line of presses, the delivery conveyor system includes a pair of endless gripper chains carrying spaced laterally disposed gripper bars and grippers which are used to grip and pull freshly printed sheets from the impression cylinder and convey the sheets toward the sheet delivery stacker. The gripper chains are driven in precisely timed relation to the impression cylinder by gripper chain sprocket wheels which are laterally spaced between a delivery drive shaft mounted on opposite sides of the press frame. The delivery drive shaft is mechanically coupled by gears for synchronous rotation with the impression cylinder.

Since the inks used with offset type printing presses typically remain wet and tacky for some time after printing, special precautions must be taken to insure that the wet inked surface of the freshly printed sheets is not marked or smeared as the sheets are transferred from one printing station to another, and through the delivery system to the sheet delivery stacker. The printed surface of the paper dries relatively slowly and can be smeared during subsequent processing, particularly when the printed sheets are stacked. In order to minimize smearing, a dryer may be mounted along the delivery path of the printed sheets, or an anti-offset spray powder may be sprayed on the printed surface.

In some printing applications, it is desirable that the press be capable of applying a protective and/or decorative coating over all or a portion of the surface of the printed sheets. Typical coating solutions include varnish, lacquer, dye, moisturizers and ink. Such coatings typically are formed of a UV-curable or water-soluble resin applied as a liquid solution or emulsion by an applicator roller over the freshly printed sheets to protect the ink and improve the appearance of the sheets. Use of such coatings is particularly desirable when decorative or protective finishes are required such as in the production of posters, record jackets, brochures, magazines, folding cartons and the like. In cases where a liquid coating is to be applied, the coating operation is carried out after the final ink printing has been performed, most desirably by an in-line coating application.

DESCRIPTION OF THE PRIOR ART

Various suggestions have been made for applying the coating as an in-line press operation by using the final printing station of the press as the coating application station. For example, in U.S. Pat. Nos. 4,270,483, 4,685,414 and 4,779,557, there are disclosed coating apparatus which can be moved into position to allow the blanket cylinder of the last printing station of a press to be used to apply a coating material to the sheets. In U.S. Pat. No. 4,796,556, there is disclosed a coating apparatus which can be selectively moved between the blanket cylinder or the plate cylinder of the last printing station of the press so that the station can be used as a coating station for the press.

Suggestions for overcoming the problem of the loss of a printing station when coating is desired have also been made, such as that set forth in U.S. Pat Nos. 4,934,305 which discloses a coating apparatus having a separate timed applicator roller positioned to apply the coating material to the printed sheet while the sheet is on the last impression cylinder of the press. This is said to allow the last printing station to be operated simultaneously as both an ink application station and a coating station so that no loss of press printing unit capability results. Another approach to providing a coating station without losing the printing capabilities of the last printing station is to provide a totally separate coating unit downstream of the last printing station so that the coating is applied to the sheets after final printing and before the sheets have reached the sheet delivery stacker. Such an approach is suggested in U.S. Pat. Nos. 4,399,767 and 4,706,601.

Conventional coating apparatus which is operable as an in-line press operation utilizes an engraved transfer roller, with the liquid coating being applied to the engraved roller by means of a doctor blade assembly. The doctor blade assembly includes an elongated housing having a reservoir chamber extending the length of the transfer roller for holding a volume of coating liquid in wetting contact with the circumferential surface of the transfer roller. A pair of circumferentially spaced doctor blades extend longitudinally along the reservoir housing on either side of the chamber. The doctor blades are angled tangentially toward the transfer roller surface, and seal the reservoir chamber against the roller surface and wipe the roller surface to deposit liquid in the cells of the engraved transfer surface.

The reservoir chamber is pressurized with coating liquid, which is pumped from a remote supply drum into the upper region of the pressure chamber. After the pressure chamber fills to a certain level, it is returned to the remote drum by gravity flow. Occasionally, the doctor blade reservoir chamber becomes completely filled with the coating liquid when the volume of coating liquid being delivered to the doctor blade reservoir chamber exceeds the gravity flow return rate. The positive pressure may cause the seals at the ends of the roller to leak, allowing the coating liquid to drip onto the floor or onto adjacent press parts. Occasionally, the coating liquid may be slung from the roller onto adjacent press equipment and operator areas. Moreover, the buildup of positive pressure within the doctor blade reservoir chamber accelerates the wear of the end seals.

It will be appreciated that the transfer roller may be operated at high speeds, for example, on the order of 1,000 linear feet per minute, and that the end seals of the doctor blade assembly will tend to wear quickly. The

end seal wear is accelerated by the buildup of positive pressure within the doctor blade chamber. Low volume drip leakage can be collected in a drip pan or catch tray, but as the end seals wear, the coating liquid will be slung from the transfer roller, thereby causing a difficult cleanup problem. When this occurs, the press must be shut down, the doctor blade head must be removed, and the end seals replaced. The steps of rebuilding or replacing the end seals and realigning the doctor blade head causes an unacceptable amount of press downtime.

One approach for overcoming the problem of end seal wear is to provide stationary end seals which are mounted on the press frame, and which bear in sealing engagement against the ends of the transfer roller, so that the doctor blade head may form a seal with stationary seals rather than with the dynamic seals carried on the transfer roller. Another approach is to use rotary end seals which include an end plate which is resiliently engaged against the end surface of the transfer roller, with a seal member being secured between the end plate and the end portions of the roller by quick removal mounting lugs.

While the foregoing mechanical approaches to limiting end seal wear and thereby avoiding leakage have been moderately successful, and some arrangements have reduced downtime by quick change mounting features, the end seals nevertheless are still experiencing accelerated wear and early failure, thereby causing frequent replacements and unacceptable downtime for correction of end seal leakage.

OBJECTS OF THE INVENTION

Accordingly, there exists a need for a new and improved in-line coating apparatus for use in a sheet-fed or web-fed, offset rotary or flexographic printing press for applying a protective and/or decorative coating to the printed surface of freshly printed sheets which does not require any expensive or substantial press modification or result in any impairment of normal press operating capability.

Specifically, the principal object of the present invention is to provide a new and improved in-line coating and/or inking apparatus of the character described which achieves a reduction in end seal leakage.

SUMMARY OF THE INVENTION

The present invention provides a new and improved inline doctor blade apparatus for applying a protective and/or decorative coating and/or inking to the surface of freshly printed sheets in a sheet-fed or web-fed, offset rotary or flexographic printing press which is highly reliable and effective in use, yet which does not require any expensive or substantial press modification or result in any impairment of normal press operating capability.

The reservoir of a doctor blade head is supplied with coating material from a remote supply drum. To insure that an adequate supply of coating liquid is always present within the doctor blade reservoir, the coating material is drawn from the remote supply drum and is circulated by suction flow constantly through the reservoir. In contrast to the conventional approach of positively pressurizing the doctor blade reservoir with liquid coating pumped from the remote drum to the reservoir, the coating material is instead circulated through the reservoir by suction flow. That is, instead of charging the reservoir with coating liquid pumped from the remote drum and thereby creating a positive pressure condition within the doctor blade reservoir, circulation through the reservoir is induced by suction flow provided by a suction pump having an input connected for drawing coating liquid from the doctor blade reservoir, and returning it by forced (positive pressure) flow to the remote supply drum, rather than by gravity flow return.

As a result of the suction flow arrangement, the liquid material is drawn from the remote supply drum at a greater rate than the rate of withdrawal of the liquid material by the pickup roller, and a substantially constant supply of liquid material will always be present within the doctor blade reservoir. A benefit of the suction flow arrangement is that a positive pressure buildup does not occur within the doctor blade chamber. Moreover, liquid material which rises above a predetermined fill level is drawn out of the doctor blade reservoir by the suction pump, and is returned to the remote drum. Consequently, the end seals are not subjected to high pressure differential conditions. Instead, the suction flow arrangement produces a negative pressure differential, with the doctor blade chamber being operated at a level below atmospheric. Under negative pressure conditions, leakage of coating liquid is virtually nonexistent, and the operating life of the end seals is substantially increased.

According to another aspect of the present invention, visual and audible alerts are provided by a vacuum sensor line which is coupled to the vacuum space within the doctor blade chamber. The sensor line is coupled to a vacuum gauge which provides a visual indication of the suction pressure within the doctor blade chamber. A vacuum sensor switch is also coupled to the chamber for selectively applying electrical power to an audio transducer when the pressure within the vacuum chamber rises above a predetermined safe operating suction level.

Other features and advantages of the present invention will become more apparent from the following detailed description taken in conjunction with the accompanying drawings which disclose, by way of example, the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic side elevational view of a sheet-fed, offset rotary printing press having a coating apparatus embodying the present invention;

FIG. 2 is an enlarged fragmentary side elevational view taken substantially within the circular area designated "2" in FIG. 1 and showing the coating apparatus of the present invention during coating operation;

FIG. 3 is an enlarged fragmentary perspective view showing one side of the coating apparatus mounted in the press and illustrating the fluid path of coating material from a remote supply drum to the doctor blade reservoir of the coating unit;

FIG. 4 is an enlarged fragmentary sectional view taken substantially along the line 4—4 of FIG. 3;

FIG. 5 is a simplified flow diagram which illustrates a dual pump arrangement for circulating coating liquid from a remote supply drum to the doctor blade reservoir and return;

FIG. 6 is a simplified flow diagram which illustrates a single pump arrangement for circulating coating liquid by suction flow from a remote supply drum to the doctor blade reservoir and return;

FIG. 7 is an enlarged fragmentary perspective view of one end portion of the doctor blade coating apparatus of the present invention;

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FIG. 8 is an enlarged sectional view taken substantially along the line 8—8 of FIG. 7; and,

FIG. 9 is a view similar to FIG. 8 which includes a suction pressure sensing circuit for providing a visual indication of suction pressure and an audible alert when the suction/vacuum pressure inside the doctor blade rises above a safe operating level, thereby signaling an impending end seal failure.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

As shown in the exemplary drawings, the present invention is embodied in a new and improved in-line doctor blade apparatus, herein generally designated 10, for use in applying a protective and/or decorative coating or inks to the freshly printed surface of sheets printed in a sheet-fed or web-fed, offset rotary or flexographic printing press, herein generally designated 12. In this instance, as shown in FIG. 1, the doctor blade coating apparatus 10 is illustrated as installed in a four color printing press 12, such as that manufactured by Heidelberger Druckmaschinen AG of the Federal Republic of Germany under its designation Heidelberg Speedmaster 102V (40"), and which includes a press frame 14 coupled at one end, herein the right end, with a sheet feeder 16 from which sheets, herein designated 18, are individually and sequentially fed into the press, and at the opposite end, with a sheet delivery stacker 20 in which the finally printed sheets are collected and stacked. Interposed between the sheet feeder 16 and the sheet delivery stacker 20 are four substantially identical sheet printing stations 22, 24, 26 and 28 which can print different color inks onto the sheets as they are moved through the press 10.

As illustrated, each of the printing stations 22, 24, 26 and 28 is substantially identical and of conventional design, herein including a sheet-fed cylinder 30, a plate cylinder 32, a blanket cylinder 34 and an impression cylinder 36, with each of the first three printing stations 22, 24 and 26 having a transfer cylinder 38 disposed to withdraw the freshly printed sheets from the adjacent impression cylinder and transfer the freshly printed sheets to the next printing station via a transfer drum 40. The final printing station 28 herein is shown as equipped with a delivery cylinder 42 which functions to support the printed sheet 18 as it is moved from the final impression cylinder 36 by a delivery conveyor system, generally designated 44, to the sheet delivery stacker 20.

The delivery conveyor system 44 as shown in FIG. 2 is of conventional design and includes a pair of endless delivery gripper chains 46, only one of which is shown carrying at regular spaced locations along the chains, laterally disposed gripper bars 48 having gripper elements 50 used to grip the leading edge of a sheet 18 after it leaves the nip between the delivery cylinder 42 and impression cylinder 36 of the last printing station 28. As the leading edge E of the sheet 18 is gripped by the grippers 50 the delivery chains 46 pull the sheet away from the impression cylinder 36 and convey the freshly printed sheet to the sheet delivery stacker 20 where the grippers release the finally printed sheet.

The endless delivery chains 46 are driven in synchronous timed relation to the impression cylinder 36 by sprocket wheels 52 fixed adjacent the lateral ends of a delivery drive shaft 54 which has a mechanically geared coupling (not shown) to the press drive system. The delivery drive shaft 54 extends laterally between the sides of the press frame 14 adjacent the impression cylinder 36 of the last printing station 28, and is disposed to be parallel with the axis of the impression cylinder. In this instance, the delivery cylinder 42, which is constructed to allow adjustments in diameter by suitable means, is attached to the delivery drive shaft 54 so that the delivery cylinder is also rotated in precise timed relation with the impression cylinder.

In this respect, it is important to note that when the freshly printed sheets 18 are conveyed away from the impression cylinder 36 of the final printing station 28 by the gripper 50 carried by the delivery chains 46, the wet inked surfaces of the sheets face the delivery drive shaft 54 and the sheets must be supported such that the ink is not smeared as the sheets are transferred. Typically, such support is provided by skeleton wheels or cylinders mounted to the press delivery drive shaft 54, or as is now more commonly used, net equipped delivery cylinders marketed by Printing Research, Inc. of Dallas, Tex. under its registered trademark SUPERBLUE. That system, which is made and sold under license, is manufactured in accordance with and operates as described in U.S. Pat. No. 4,402,267, issued Sep. 6, 1983, to Howard W. DeMoore, the disclosure of which is incorporated herein by this reference.

More recently, vacuum transfer apparatus of the type disclosed in co-pending U.S. application Ser. No. 07/630,308, filed Dec. 18, 1990, entitled "Vacuum Transfer Apparatus for Sheet-Fed Printing Presses", which is also incorporated herein by reference, has been used. The vacuum transfer apparatus disclosed in that application can be used in place of delivery cylinders or skeleton wheels to pull the unprinted side of the sheet away from the delivery drive shaft 54 so that the wet ink surface of the sheets do not come into contact with any press apparatus.

In accordance with the present invention, the in-line doctor blade coating apparatus 10 for applying the protective or decorative coating or ink to the sheets 18 enables the press 12 to be operated in the normal manner without the loss of the final printing station 28, and without requiring any substantial press modifications by employing the existing press delivery drive shaft 54 as the mounting location for the coating applicator roller. In presses having delivery systems such as skeleton wheels mounted on the delivery drive shaft 54 or a vacuum transfer apparatus as disclosed in the aforementioned co-pending U.S. application Ser. No. 07/630,308, conversion to a coating operation can be quickly and easily achieved by mounting on the press delivery drive shaft in place of the skeleton wheels or in addition to the vacuum transfer apparatus, a suitable support cylinder capable of performing the combined function of a coating applicator roller and a net enhanced delivery cylinder 42. By utilizing the delivery cylinder 42 mounted on the delivery drive shaft 54 to also act as a coating applicator roller, protective coating will be applied to the printed sheet 18 in precise timed registration, and will permit the press to be operated with its full range of printing stations.

Toward these ends, the coating apparatus 10 of the present invention includes a relatively simple, positive acting and economical doctor blade coating unit, generally designated 60, mounted to the press frame 14 downstream of the delivery drive shaft 54 and positioned to apply liquid coating material to the support surface of a delivery cylinder 42 mounted on the delivery drive shaft. As can best be seen in FIGS. 2, 3 and 4, the doctor blade coating unit 60 herein comprises a pair of side

frames 62, only one of which is shown, it being understood that the other side frame is substantially the same as that of the side frame illustrated, attached to each side of the press frame 14. Pivotally mounted to one end of each of the side frames 62 is a support bracket 64 carrying one end of a liquid material reservoir 66 and cooperating liquid material pickup roller 68 each disposed to extend laterally across the press 12 parallel with the delivery drive shaft 54. The coating unit 60 is mounted between the upper and lower runs of the delivery chains 46 downstream of the delivery drive shaft 54, and positioned so that the outer peripheral surface 70 of the pickup roller 68 can be engaged with the support surface of a delivery cylinder 42 mounted on the delivery drive shaft.

As best seen in FIGS. 2 and 3, the support bracket 64 is pivotally attached to the end of the side frame 62 by a shaft 72 disposed at the lower end portion of the bracket, and can be pivoted about the shaft by an extensible cylinder 74, herein shown as a pneumatic cylinder, one end 76 of which is secured such as by welding to the side frame, and the opposite end 78 of which is coupled through a pivot shaft 79 to the upper end portion of the bracket. By extending or retracting the cylinder 74, the extent of engagement of the pickup roller 68 against the surface of the applicator roller 42 can be controlled, and the pickup roller can be completely disengaged from the applicator roller 42.

The coating pickup roller 68, which is of conventional design and preferably one such as the Anilox rollers manufactured by A.R.C. International of Charlotte, N.C. and sold under the name "PRINTMASTER" having an engraved ceramic or chrome outer peripheral surface 70, is designed to pick up a predetermined uniform thickness of liquid coating material or ink from the reservoir 66, and then uniformly transfer the coating material to the support surface of the applicator roller 42. To effect rotation of the pickup roller 68, a suitable motor 80, herein a hydraulic motor, is attached to one of the side frames 62 and coupled to a suitable hydraulic fluid source (not shown) through fittings 81A, 81B. Attached to the output of the motor 80 is an output gear which is drivingly coupled through a cluster gear 82 and a series of idler gears 83 each mounted on stub axles 84, to a drive gear 86 attached to the end of a shaft 88 on which the pickup roller 68 is concentrically mounted. The shaft 88 of the pickup roller 68 is, in turn, journaled at each end to the brackets 64 through a releasable semicircular collar 90 attached by bolts 92 to the bracket. Herein, the axle of the terminal idler gear, designated 83', also serves as the shaft 72 for pivotally mounting the support bracket 64 to the side frame 62 so that when the bracket is rotated about the shaft, the terminal idler gear remains engaged with the drive gear 86 of the pickup roller 68.

In this instance, as can best be seen in FIG. 4, the pickup roller 68 has a peripheral surface portion 68P which projects radially into the reservoir 66 containing the supply of coating material or ink. A pair of upper and lower inclined doctor blades 94 and 96 attached to the doctor blade head 98 on shoulders 98A, 98B engage the roller surface to doctor the excess liquid coating material or ink picked up from the reservoir by the engraved surface 70 of the roller. The reservoir cavity 66 herein is formed within an elongated doctor blade head 98 having a generally C-shaped cross-section with an opening 100 extending longitudinally along one side facing the pickup roller 68. The reservoir 66 is supplied with liquid material or ink from a supply drum 102 disposed in a remote location within or near the press 12. preferably, the doctor blade head 98 is removably attached to the brackets 64, herein by bolts 104 having enlarged, knurled heads 106, and which can be threaded through slots 108 formed in the brackets to clamp the reservoir in place on the brackets.

To insure that an adequate supply of liquid coating material is always present within the reservoir 66 and to prevent coagulation and clogging of the doctor blades 94 and 96 by the liquid coating material or ink, the coating material or ink is circulated through the reservoir by two pumps 110 and 112 as shown in FIG. 5. Pump 110 draws the liquid material L from the supply drum 102 via a supply line 114 and discharges it into a bottom region of the reservoir 66 through a delivery port 114P, and the other pump 112 acts to provide suction to a pair of return lines 116A, 116B coupled adjacent a top region of the reservoir through return ports 116P, 116Q for withdrawing excess liquid coating material or ink from the reservoir. By supplying the coating material or ink from the supply drum 102 at a greater rate than the rate of withdrawal of material by the pickup roller 68, a substantially constant supply of coating material or ink will always be present within the reservoir 66. The excess coating material or ink which rises above the liquid level of the return port R (FIG. 8) is suctioned away by the suction return pump 112.

The general arrangement of the pickup roller 68, doctor blades 94 and 96, and reservoir 66 is similar to that disclosed in U.S. Pat. No. 4,821,672 entitled "Doctor Blade Assembly With Rotary End Seals and Interchangeable Heads", the disclosure of which provides details concerning the end seal structure and operation of a pickup roller and reservoir usable with the present invention. According to an important feature of the present invention, however, the doctor blade reservoir 66 is not pressurized as taught by the prior art. Instead, coating liquid or ink is supplied to the doctor blade reservoir 66 by the suction flow produced by the pump 112. In this arrangement, the suction pump 112 applies a vacuum or suction force in the reservoir which draws liquid material L from the supply through the supply conduit 114 to the reservoir and draws excess liquid material L from the doctor blade reservoir 66 through the return conduit 116 into the remote reservoir 102 at a rate which is greater than the rate that liquid coating material or ink is being supplied to the doctor blade reservoir through the supply conduit 114. Because the suction return flow rate is greater than the supply flow rate, a positive pressure condition within the doctor blade reservoir is avoided, and a below atmospheric vacuum pressure level is provided.

Referring to FIG. 5, FIG. 6, FIG. 7 and FIG. 8, the liquid material is delivered into the lower region of the doctor blade reservoir 66, and is withdrawn from the doctor blade reservoir near an upper region of the chamber through the return conduits 116A, 16B. The liquid level elevation of the return port is preferably selected to provide for the accumulation of liquid coating material or ink in more than about half of the doctor blade chamber, thereby insuring that the engraved surface of the pickup roller 68 will be thoroughly wetted by the coating material or ink L as it turns through the doctor blade chamber 66. The reservoir 66 is bounded vertically by lower and upper doctor head shoulders 98A, 98B. Accordingly, the return ports 116P, 116Q of return lines 116A, 116B are located at a liquid level R

intermediate the limits established by the lower and upper shoulders. Any excess liquid coating material or ink which rises above the liquid level R of the return ports will be suctioned away by the pump 112.

It will be appreciated that the supply pump 110 is optional, and that the suction circulation system can be operated effectively with only the single suction pump 112 as shown in FIG. 6. In the single pump configuration, it may be necessary to prime the supply conduit 114 to obtain satisfactory operation. The two pump arrangement as shown in FIG. 5 is preferred for those installations in which the supply drum 102 is located at a distance that is too far from the press to achieve adequate suction flow. The auxiliary supply pump 110 provides positive flow input to the doctor blade reservoir at a fixed flow rate. The return suction pump 112 has a faster suction flow rate than the supply flow rate. Consequently, a positive pressure buildup in the doctor blade reservoir cannot occur. By utilizing two pumps as shown in FIG. 5, the liquid level within the doctor blade chamber 66 can be closely controlled, without positive pressure buildup, thereby reducing leakage through the end seals.

Referring to FIG. 8, it will be appreciated that the doctor blade chamber 66 is maintained at a pressure level below atmospheric by the suction action of the return flow pump 112. The coating liquid L rises to the liquid level of the return port R and is drawn off immediately by the suction pump 112. Additionally, air within the doctor blade chamber 66 is also evacuated, thereby reducing the doctor blade chamber pressure to a level below atmospheric. This negative pressure differential condition opposes leakage of coating liquid L through the end seals. Since the doctor blade chamber 66 is not positively pressurized, the end seals are operated under favorable pressure differential conditions, thereby extending their useful lifetime. Moreover, the negative pressure differential doctor blade assembly will accommodate a pickup roller having a chipped corner, which would leak under positive pressure conditions, but does not leak because of the negative pressure reservoir condition established by suction flow.

It is useful for the press operator to have an advance warning of an impending end seal failure. With advance warning, the press operator can schedule repair and/or replacement of the doctor blades and the end seals at a convenient time, for example between press runs or before undertaking the next printing job. Apparatus for monitoring the suction/vacuum condition within the doctor blade chamber 66 is provided by a pneumatic sensor circuit 120 as shown in FIG. 9. The pneumatic sensor circuit 120 includes a pneumatic sensor line 122 which is coupled in fluid communication with the doctor blade chamber 66 through a vacuum sensor bore 124 formed through the upper doctor head shoulder 98B. The vacuum sensor line 122 is coupled to the sensor bore 124 by a threaded fitting 126.

Continuous monitoring of the vacuum/suction condition within the doctor blade chamber 66 is provided by a vacuum gauge 128 which can be of any conventional design, for example a Bourdon gauge which is calibrated for dry air and covers the range from about zero to about twenty torrs. The vacuum gauge 128 is coupled into the sensor line 122 by a tee coupling 130. According to this arrangement, the press operator receives a continuous visual indication of the vacuum/suction condition within the doctor blade chamber 66.

According to another feature of the invention, the vacuum/suction line 122 is coupled to a vacuum switch 132. The vacuum switch 132 has a conductive, movable diaphragm 134 which moves into and out of electrical contact with switch electrodes 132A, 132B. That is, the diaphragm 134 is pulled out of contacting engagement with the switch electrodes 132A, 132B when the vacuum/suction level in the doctor blade chamber 66 is below a predetermined level. When the pressure level within the doctor blade chamber 66 rises above that preset level, for example in response to leakage of air through the end seals or around a worn doctor blade 94, the vacuum force within the vacuum chamber 132C of the sensor switch also rises, thereby permitting the conductive switch element 134 to engage the switch electrodes 132A, 132B.

When switch closure occurs, electrical power is applied to an audio transducer 136 from a power source 138. Electrical current is conducted through the pneumatic switch 132 to the audio transducer 136 through power conductors 140, 142. According to this arrangement, the press operator will receive an audible alert as soon as the suction/vacuum pressure in the doctor blade chamber rises above a safe operating level, thereby signaling wear failure of the doctor blades and/or an impending failure of the end seals.

From the foregoing, it should be apparent that the coating apparatus 10 of the present invention provides a highly reliable, effective and economical in-line apparatus for applying coating material to the freshly printed sheets 18 in a sheet-fed, offset rotary printing press 12 which allows the final printing station to continue to be used as a print station, yet which does not require any substantial press modification or the addition of a separate timed applicator roller. While a particular form of the present invention has been illustrated and described, it should be apparent that variations and modifications therein can be made without departing from the spirit and scope of the invention.

What is claimed is:

1. Apparatus for applying liquid material from a supply to a pickup roller comprising in combination:

a doctor blade head having an elongated reservoir for receiving liquid material from the supply, said doctor blade head being adapted to extend in parallel with the pickup roller in an operative position with a portion of the peripheral surface of the pickup roller extending into said reservoir for wetting contact with liquid material contained therein, and two doctor blades attached to said doctor blade head for engagement against said peripheral surface in the operative position;

a supply conduit connecting said supply in flow communication with said reservoir;

a return conduit connecting said reservoir in flow communication with said supply; and,

a first pump coupled in series flow relation with said return conduit for inducing suction flow of liquid material from said reservoir through said return conduit into said supply.

2. Apparatus as defined in claim 1, including:

a second pump coupled in series flow relation with said supply conduit for pumping liquid material from said supply to said reservoir.

3. Apparatus as defined in claim 2, wherein the suction return pumping rate of said first pump is greater than the supply pumping rate of said second pump.

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4. Apparatus as defined in claim 1, said doctor blade head having first and second shoulders forming lower and upper liquid level boundaries for said reservoir, respectively, wherein the return conduit is coupled in flow communication with said reservoir at a liquid level location disposed intermediate the liquid level boundaries established by said first and second shoulders.

5. Apparatus as defined in claim 1, wherein the return conduit is coupled in flow communication with said reservoir at a first liquid level location and the supply conduit is coupled in flow communication with said reservoir at a second liquid level location, the first liquid level location of the return conduit being higher in elevation than the second liquid level location of the supply conduit when the doctor blade head is in the operative position.

6. Apparatus for applying liquid material from a supply to a pickup roller comprising, in combination:

an elongated doctor blade head having an elongated cavity formed therein defining a reservoir for receiving liquid material from the supply, said doctor blade head being adapted to extend in parallel with the pickup roller in an operative position with a portion of the peripheral surface of the pickup roller extending into said cavity for wetting contact with liquid material contained therein, and a pair of doctor blades disposed on opposite sides of said cavity and extending the length thereof for engagement against the peripheral surface of the pickup roller in the operative position; and,

means coupled to said supply and to said reservoir for inducing flow of liquid material from said supply into said reservoir and for returning excess liquid material by suction force from said reservoir to said supply.

7. Apparatus as defined in claim 6, said inducing means comprising:

a supply conduit connecting said supply in flow communication with said reservoir;

a return conduit connecting said reservoir in flow communication with said supply; and,

a first pump coupled in series flow relation with said return conduit for inducing suction flow of liquid material from said supply through said supply conduit into said reservoir, and for inducing suction flow of liquid material from said reservoir through said return conduit into said supply.

8. Apparatus as defined in claim 7, said means including:

a second pump coupled in series flow relation with said supply conduit for pumping liquid material from said supply to said reservoir.

9. Apparatus as defined in claim 8, wherein the suction return pumping rate of said first pump is greater than the supply pumping rate of said second pump.

10. Apparatus as defined in claim 6, said doctor blade head having first and second shoulders forming lower and upper liquid level boundaries for said reservoir, respectively, wherein said means for inducing suction flow includes a return conduit coupled in flow communication with said reservoir at a liquid level location disposed intermediate the liquid level boundaries established by said first and second shoulders.

11. Apparatus for applying liquid material from a supply to a pickup roller comprising in combination:

a doctor blade head having an elongated reservoir for receiving liquid material from the supply, said doctor blade head being adapted to extend in parallel with the pickup roller in an operative position with a portion of the peripheral surface of the pickup roller extending into said reservoir for wetting contact with liquid material contained therein, and two doctor blades attached to said doctor blade head for engagement against said peripheral surface in the operative position;

first means coupled to said supply and to said reservoir for pumping liquid material from said supply into said reservoir; and,

second means coupled to said reservoir and to said supply for inducing suction flow of liquid material from said reservoir into said supply.

12. Apparatus for applying liquid material from a supply to a pickup roller comprising in combination:

a doctor blade head having an elongated reservoir chamber for receiving liquid material from the supply, said doctor blade head being adapted to extend in parallel with the pickup roller in an operative position with a portion of the peripheral surface of the pickup roller extending into said reservoir chamber for wetting contact with liquid material contained therein, and two doctor blades attached to said doctor blade head for engagement against said peripheral surface in the operative position; and,

a suction pump coupled to said reservoir and to said supply for inducing suction flow of liquid material from said reservoir to said supply.

13. Apparatus as defined in claim 12, including a pneumatic sensor conduit coupled to said reservoir chamber for sensing the air vacuum pressure within said reservoir chamber, and a vacuum gauge coupled to said sensor conduit for providing a visual indication of air vacuum pressure in said reservoir chamber.

14. Apparatus as defined in claim 12, including a pneumatic sensor conduit coupled to said reservoir chamber for sensing the air vacuum pressure within said reservoir chamber, a vacuum responsive switch having a sensing chamber coupled to said sensor conduit and switch electrodes and an audio transducer electrically connected to said switch electrodes for making and breaking an electrical circuit from a power source to said audio transducer.

15. In a sheet-fed, offset rotary printing press of the type including at least one printing station having a blanket cylinder and an impression cylinder disposed for printing ink onto sheets passing therebetween, and a delivery conveyor system for pulling freshly printed sheets from the impression cylinder and transporting the printed sheets toward a sheet delivery stacker, the delivery conveyor system including a delivery drive shaft disposed adjacent to and extending parallel with the impression cylinder and driven in timed synchronous relation with the impression cylinder, the improvement comprising:

a delivery cylinder mounted onto said delivery drive shaft and having an outer peripheral support surface adapted to engage and support a sheet being transported by said delivery conveyor system;

a coating apparatus including a supply of liquid material, a rotatable pickup roller having an outer peripheral surface of substantially cylindrical shape, and means for applying a coating of liquid material from said supply onto said outer peripheral surface of said pickup roller;

means for mounting said coating apparatus to the press adjacent said delivery cylinder with a portion

of said peripheral surface of said pickup roller engaged with the support surface of said delivery cylinder, whereby liquid coating material from said supply applied onto the peripheral surface of said pickup roller is transferred to said support surface of said delivery cylinder and to said freshly printed sheet;

said coating apparatus including an elongated reservoir for receiving liquid material from said supply, said reservoir extending parallel with said pickup roller with a portion of the peripheral surface of the pickup roller extending into said reservoir for wetting contact with liquid material contained therein, and two doctor blades attached to said reservoir and engaging said peripheral surface, said doctor blades acting to limit the amount of liquid material applied onto said peripheral surface from said reservoir;

a supply conduit connecting said supply in flow communication with said reservoir;

a return conduit connecting said reservoir in flow communication with said supply; and,

a first pump coupled in series flow relation with said return conduit for inducing suction flow return of liquid material from said reservoir to the remote supply.

16. The improvement as set forth in claim 15, wherein said coating apparatus is mounted to said press downstream of said delivery drive shaft in the direction of travel of said sheets during transport by said delivery conveyor system.

17. The improvement as set forth in claim 15, including:

a second pump coupled in series flow relation with said supply conduit for liquid material from the remote supply to said reservoir.

18. The improvement as set forth in claim 17, wherein the suction return flow rate of said first pump is greater than the positive pressure supply flow rate of said second pump.

19. The improvement as set forth in claim 15, wherein the return conduit is coupled in flow communication with said reservoir at a first liquid level location and the supply conduit is coupled in flow communication with said reservoir at a second liquid level location, the first liquid level location of the return conduit being higher than the second liquid level location of the supply conduit.

20. In a sheet-fed, offset rotary printing press of the type including at least one printing station having a blanket cylinder and an impression cylinder disposed for printing wet ink onto sheets passing therebetween, and a delivery conveyor system for pulling freshly printed sheets from the impression cylinder and transporting the printed sheets toward a sheet delivery stacker, the delivery conveyor system comprising a pair of endless gripper chains disposed on opposite sides of the press and supporting therebetween gripper bars and grippers spaced along the chains, the gripper chains being driven in timed synchronous relation with the impression cylinder by laterally spaced sprocket wheels mounted on opposite ends of a delivery drive shaft disposed adjacent to and extending parallel with the impression cylinder, the improvement comprising:

a delivery cylinder mounted to said delivery drive shaft between said sprocket wheels and having an outer peripheral support surface covered by a removable coating blanket adapted to engage and support the wet ink side of a sheet being transported by said gripper bars;

a coating apparatus including a supply of liquid material, a rotatable pickup roller having an outer peripheral surface of substantially cylindrical shape, and means for applying liquid material from said supply onto said peripheral surface of said pickup roller;

means for mounting said coating apparatus to the press adjacent the delivery cylinder, with a portion of the outer peripheral surface of said pickup roller engaged with said delivery cylinder, whereby liquid material doctored onto the peripheral surface of said pickup roller is transferred to said delivery cylinder and to said freshly printed sheet;

said coating apparatus including an elongated reservoir containing liquid material, said reservoir being disposed to extend parallel with said pickup roller with a portion of said peripheral surface extending into said reservoir in contact with liquid material contained therein, and two doctor blades attached to said reservoir and engaging said peripheral surface, said doctor blades acting to limit the amount of liquid coating material applied onto said peripheral surface from said reservoir;

a supply conduit connecting said supply in flow communication with said reservoir;

a return conduit connecting said reservoir in flow communication with said supply; and,

a first pump coupled in series flow relation with said return conduit for inducing suction flow return of liquid material from said reservoir to said supply.

21. A sheet-fed, offset rotary printing press including:

at least one printing station having a blanket cylinder and an impression cylinder disposed for printing wet ink onto sheets passing therebetween;

a delivery conveyor system for pulling freshly printed sheets from the impression cylinder and transporting the printed sheets toward a sheet delivery stacker, the delivery system including a delivery drive shaft;

a delivery cylinder mounted to said delivery drive shaft and having an outer peripheral support surface adapted to engage and support a sheet being transported by said delivery conveyor system;

a coating apparatus including a supply of liquid material, a rotatable pickup roller having an outer peripheral surface of substantially cylindrical shape, and means for applying liquid material from said supply onto the peripheral surface of said pickup roller;

means for mounting said coating apparatus to the press adjacent said delivery cylinder, with a portion of said peripheral surface of said pickup roller engaged with said delivery cylinder, whereby liquid material applied to the peripheral surface of said pickup roller is transferred to said delivery cylinder and then to said freshly printed sheet;

said coating apparatus including an elongated reservoir containing liquid material, said reservoir being disposed to extend parallel with said pickup roller with a portion of said peripheral surface extending into the reservoir in contact with liquid material contained therein, and two doctor blades attached to said reservoir and engaging said peripheral surface, said doctor blades acting to limit the amount of liquid coating material applied onto said peripheral surface from said reservoir;

a supply conduit connecting said supply in flow communication with said reservoir;

a return conduit connecting said reservoir in flow communication with said supply; and,

a first pump coupled in series flow relation with said return conduit for inducing suction flow return of liquid material from said reservoir to said supply.

* * * * *

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United States Patent [19]

DeMoore et al.

[11] Patent Number: 5,335,596

[45] Date of Patent: * Aug. 9, 1994

[54] COATING APPARATUS FOR SHEET-FED, OFFSET ROTARY PRINTING PRESSES

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[*] Notice: The portion of the term of this patent subsequent to May 4, 2010 has been disclaimed.

[21] Appl. No.: 52,763

[22] Filed: Apr. 26, 1993

Related U.S. Application Data

[63] Continuation of Ser. No. 879,841, May 6, 1992, Pat. No. 5,207,159, which is a continuation-in-part of Ser. No. 752,778, Aug. 30, 1991, Pat. No. 5,176,077.

[51] Int. Cl.^{5} B41F 31/00

[52] U.S. Cl. 101/350; 101/351; 101/367; 101/147; 118/261

[58] Field of Search 101/350, 351, 352, 137, 101/147, 148, 157, 167, 169, 207, 208, 219, 329, 330, 331, 348, 349, 364, 365, 366, 367; 118/602, 612, 236, 242, 259, 261, 262

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5,207,159	5/1993	DeMoore et al.	101/350

FOREIGN PATENT DOCUMENTS

6071180	2/1983	European Pat. Off.	101/364
6270054	6/1988	European Pat. Off.	101/419
2151185	7/1979	Fed. Rep. of Germany	101/424 2

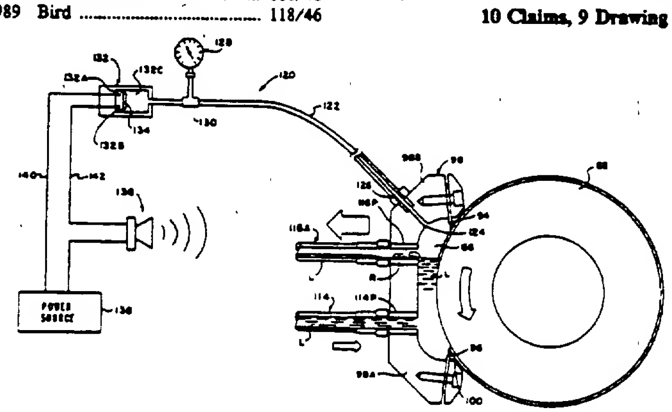
Primary Examiner—Eugene H. Eickholt

Attorney, Agent, or Firm—Dennis T. Griggs

[57] **ABSTRACT**

A coating apparatus for use in a sheet-fed or web-fed, offset rotary or flexographic printing press to apply a protective and/or decorative coating to the surface of freshly printed sheets includes a doctor blade coating unit coupled to a pickup roller for supplying liquid material from a reservoir to the surface of a pickup roller mounted on a press delivery drive shaft. Liquid material is circulated through the reservoir of the doctor blade unit by suction flow produced by a return pump. This prevents the buildup of a positive pressure differential within the doctor blade reservoir. The doctor blade reservoir is maintained at below ambient pressure level, thereby preventing leakage through the end seals. A vacuum sensor circuit provides a visual indication of air vacuum pressure in the doctor blade reservoir chamber, and a vacuum sensor switch applies electrical power to an audio transducer. The audio transducer produces an audible alarm in response to an increase in doctor blade chamber pressure, thereby providing advance warning of an impending end seal failure or a worn doctor blade condition.

10 Claims, 9 Drawing Sheets



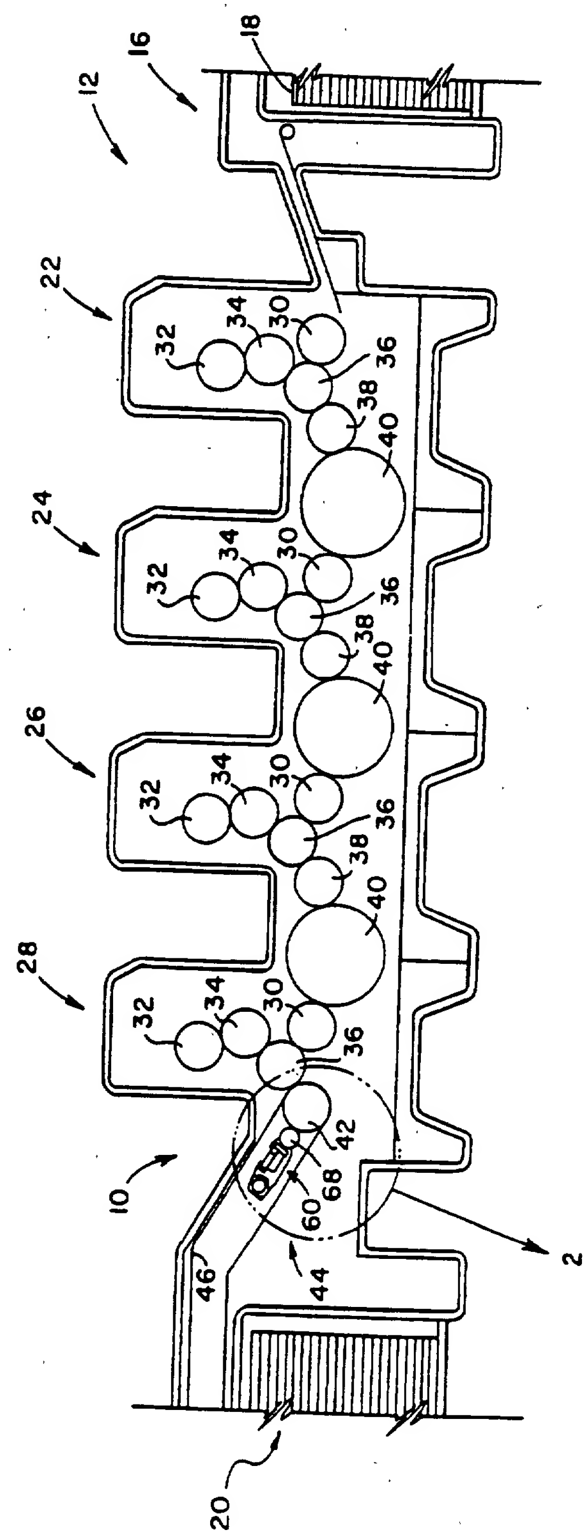


FIG. 1

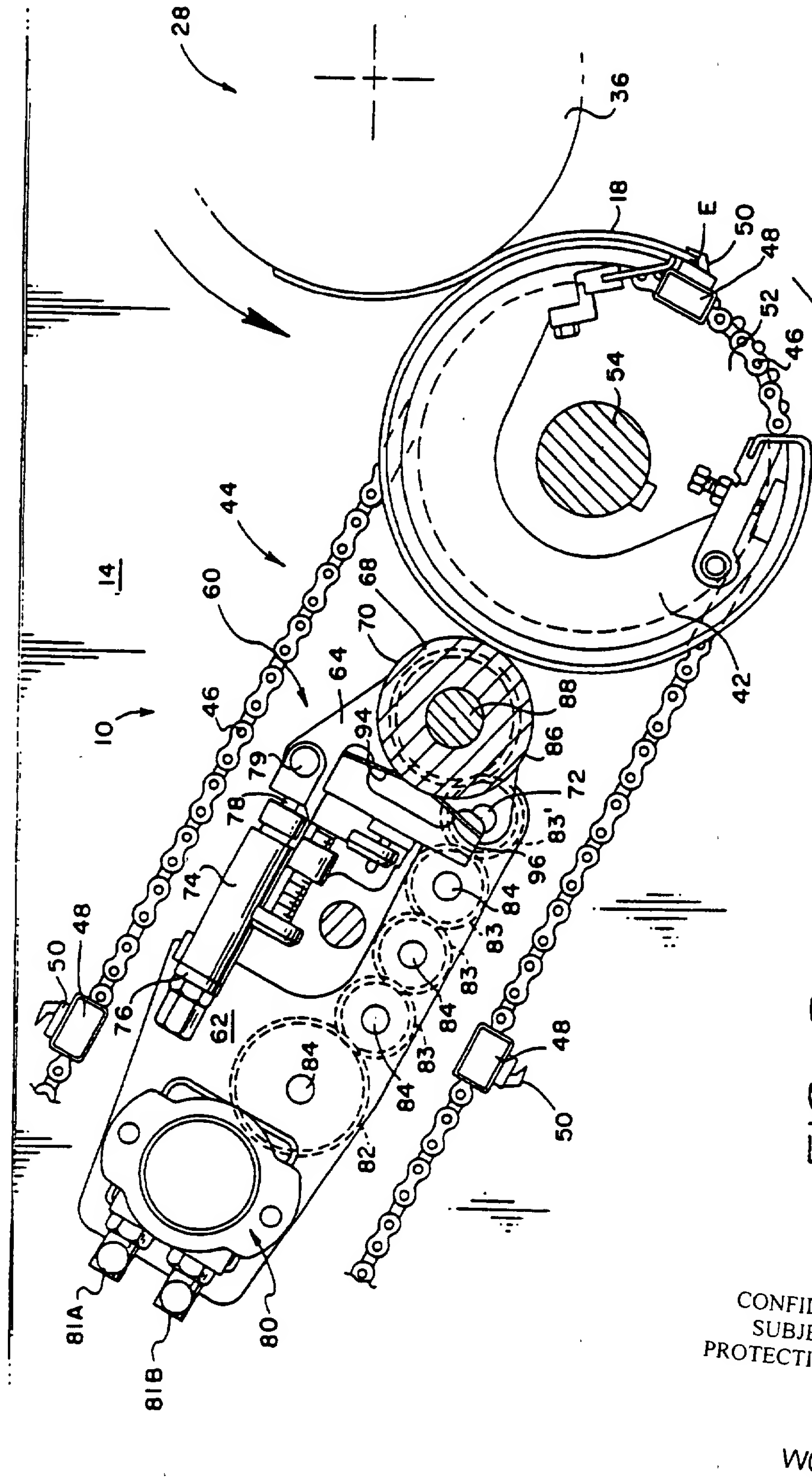
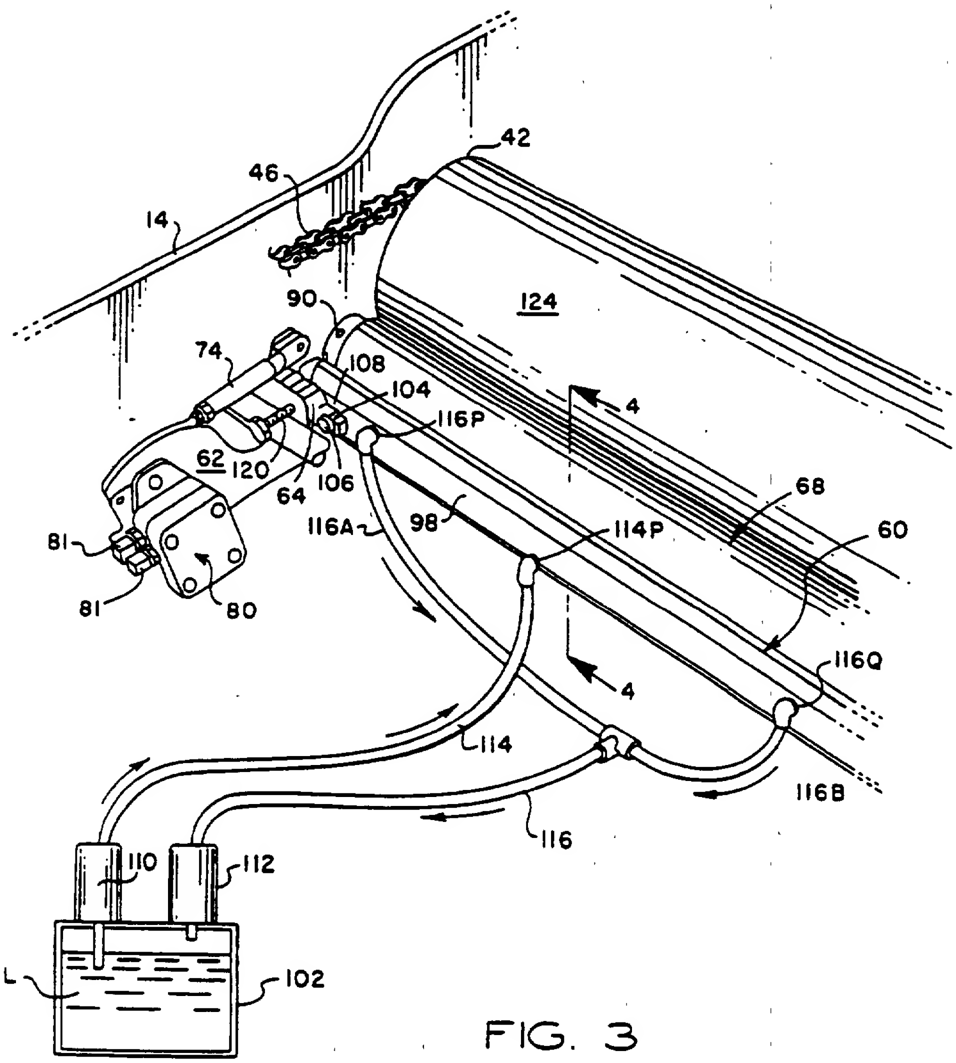

28
36
18
E
50
48
52
46
54
44
14
60
68
70
64
10
46
94
88
86
79
78
72
83'
96
74
84
83
42
48
50
76
62
82
81A
81B
80

FIG. 2



42
46
14
90
124
74
108
104
116P
4
62
120
64
106
68
60
81
116A
98
114P
81
80
116Q
4
114
116B
116
110
112
L
102

FIG. 3

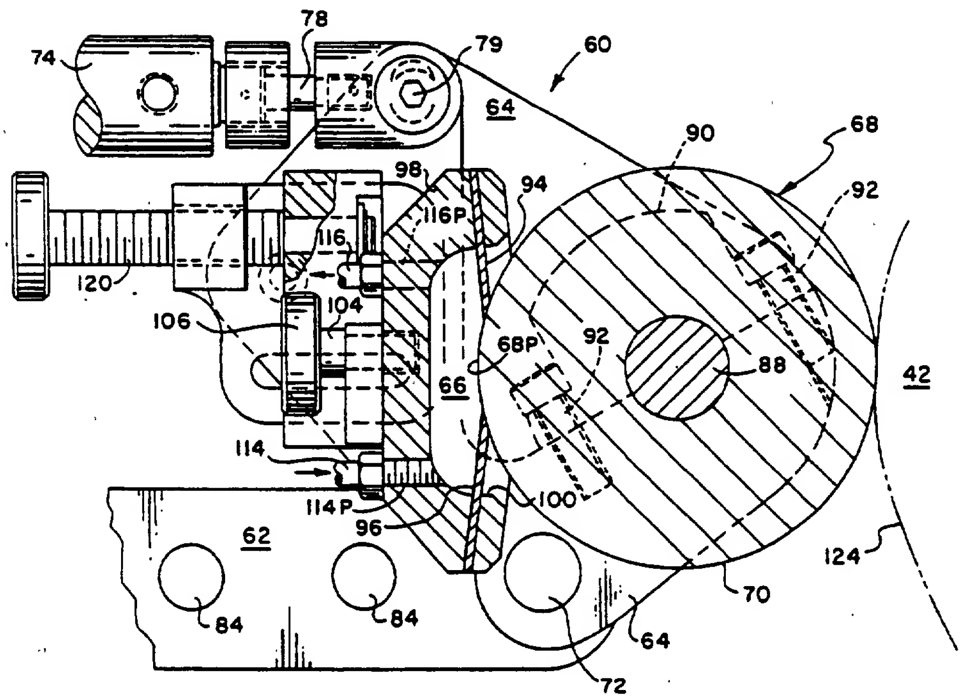

78
74
79
60
64
90
68
92
98
94
116P
116
120
104
106
68P
92
88
42
66
114
114P
100
96
62
124
70
84
84
64
72

FIG. 4

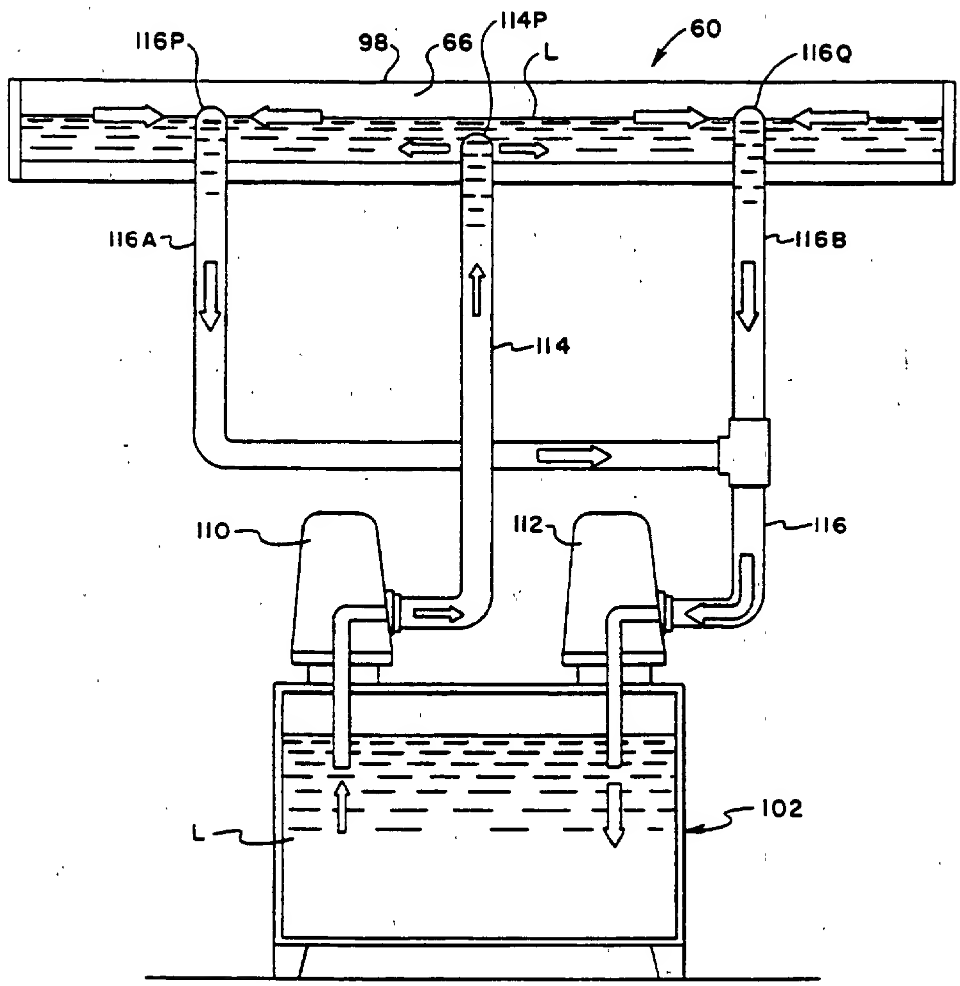


FIG. 5

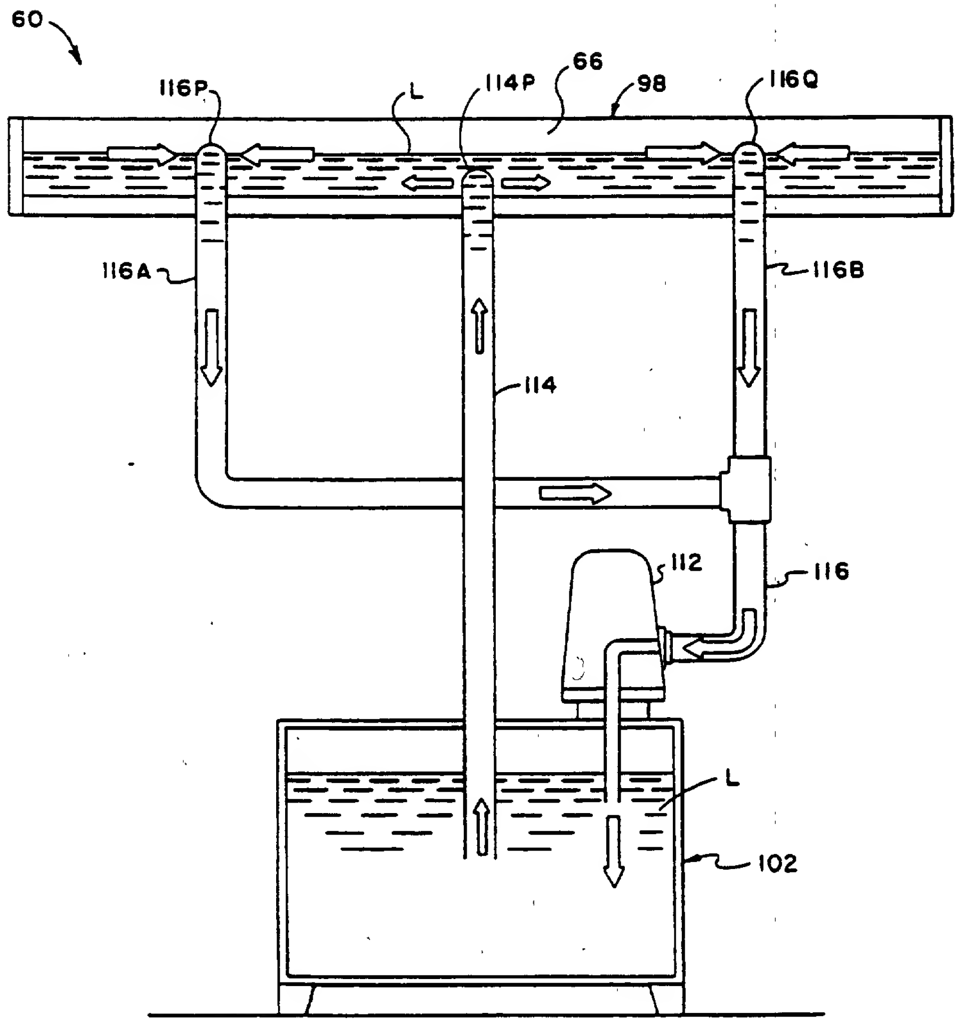


FIG. 6

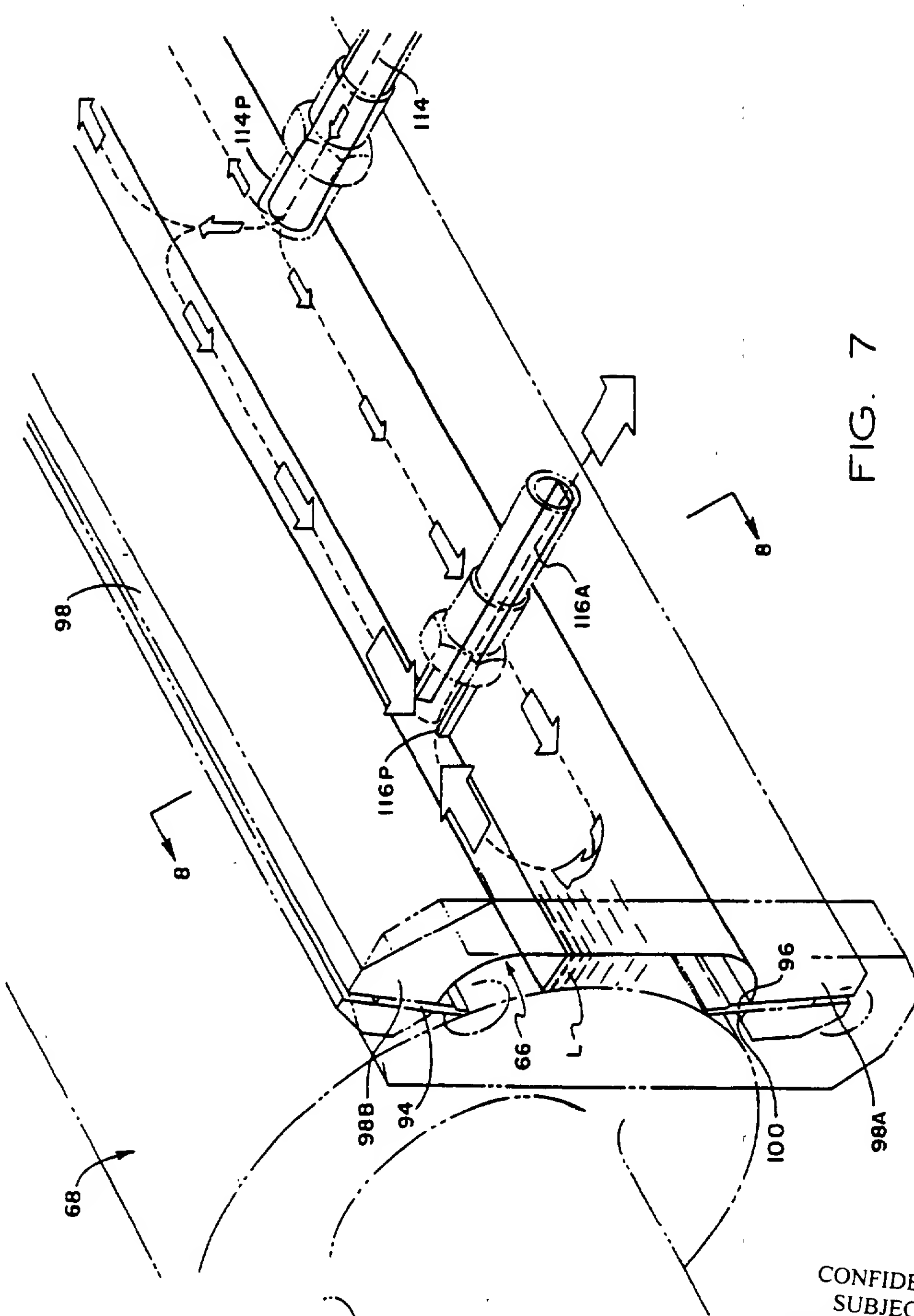


FIG. 7

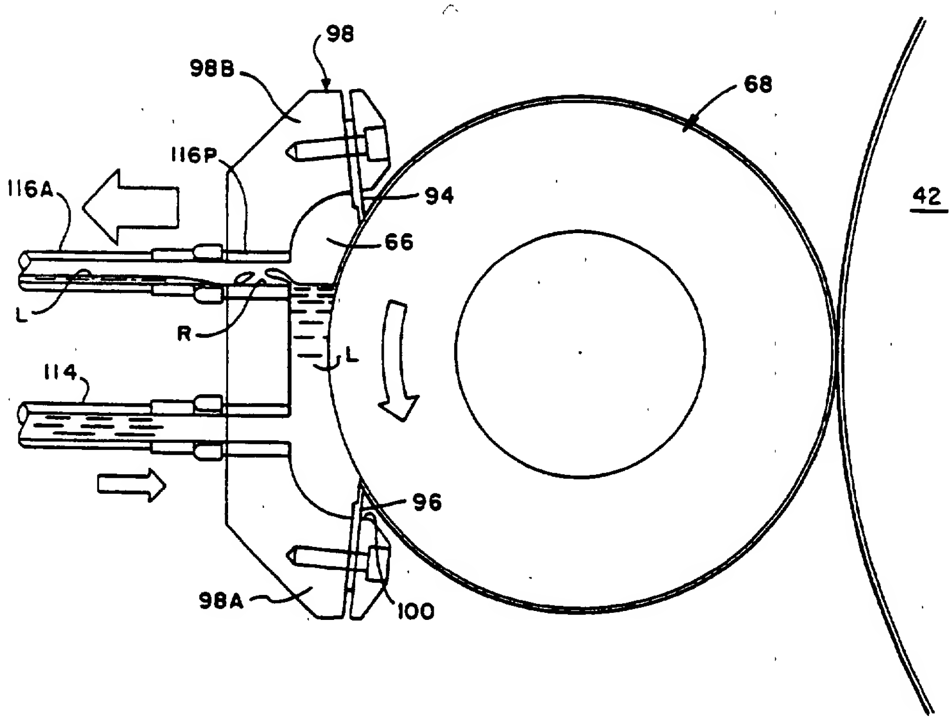


FIG. 8

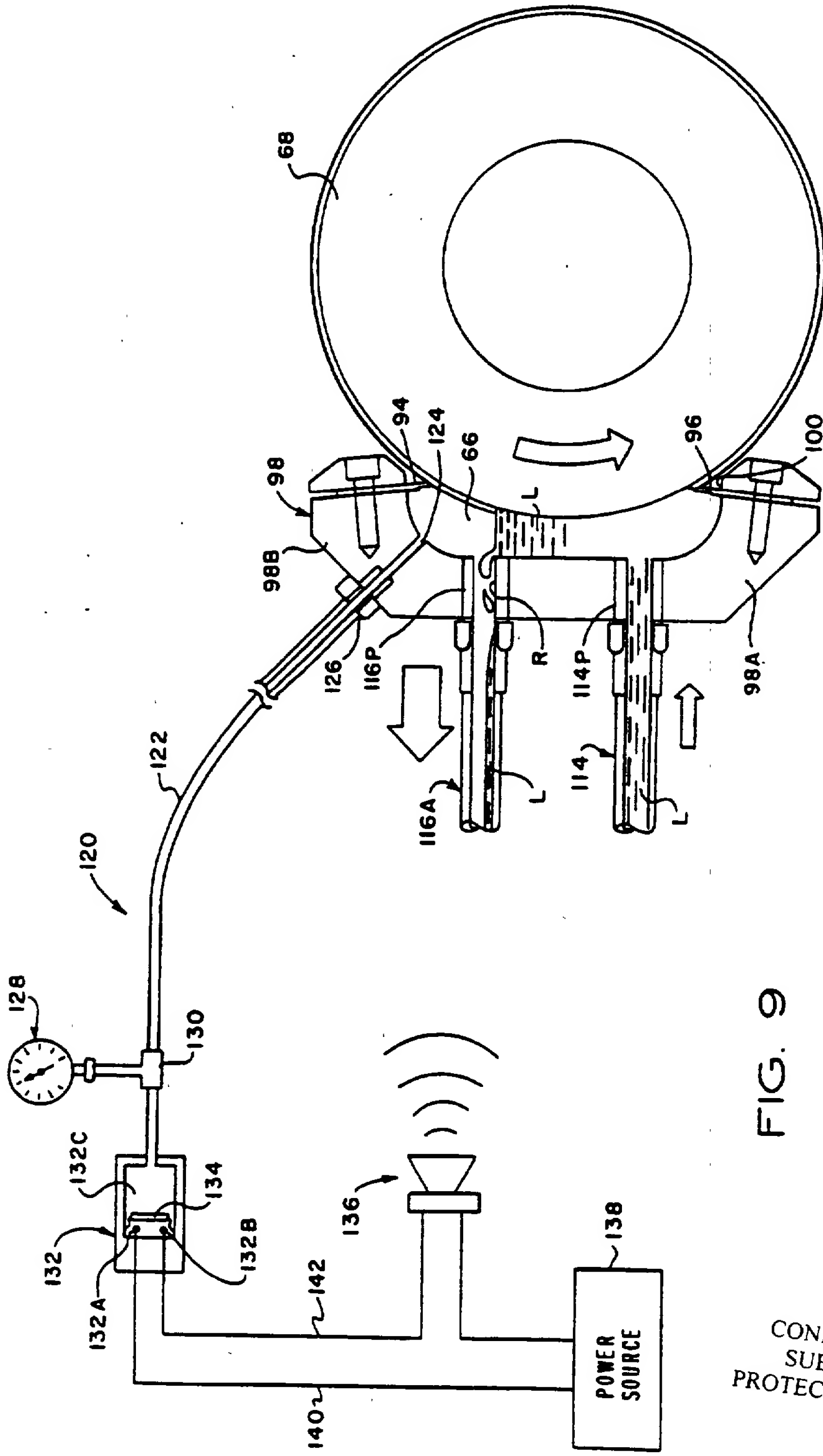

68
94
124
66
96
100
98
L
98B
116P
R
114P
98A
126
116A
114
122
120
128
130
132C
134
136
132
132B
132A
142
138
POWER SOURCE
140

FIG. 9

COATING APPARATUS FOR SHEET-FED, OFFSET ROTARY PRINTING PRESSES

CROSS REFERENCE TO RELATED APPLICATION

This is a continuation of application Ser. No. 07/879,841, filed May 6, 1992 now U.S. Pat. No. 5,207,159 which is a continuation-in-part of application Ser. No. 07/752,778 filed Aug. 30, 1991 now U.S. Pat. No. 5,176,077.

FIELD OF THE INVENTION

This invention relates to sheet-fed or web-fed, offset rotary or flexographic printing presses, and more particularly, to a new and improved apparatus for the in-line application of protective and decorative coatings or inks to the printed surface of freshly printed sheets or web.

BACKGROUND OF THE INVENTION

Conventional sheet-fed, offset rotary printing presses typically include one or more printing stations through which individual sheets are fed and printed with wet ink. After final printing, the sheets are fed by a delivery conveyor system to the delivery end of the press where the freshly printed sheets are collected and stacked. In a typical sheet-fed, offset rotary printing press such as the Heidelberg Speedmaster line of presses, the delivery conveyor system includes a pair of endless gripper chains carrying spaced laterally disposed gripper bars and grippers which are used to grip and pull freshly printed sheets from the impression cylinder and convey the sheets toward the sheet delivery stacker. The gripper chains are driven in precisely timed relation to the impression cylinder by gripper chain sprocket wheels which are laterally spaced between a delivery drive shaft mounted on opposite sides of the press frame. The delivery drive shaft is mechanically coupled by gears for synchronous rotation with the impression cylinder.

Since the inks used with offset type printing presses typically remain wet and tacky for some time after printing, special precautions must be taken to insure that the wet inked surface of the freshly printed sheets is not marked or smeared as the sheets are transferred from one printing station to another, and through the delivery system to the sheet delivery stacker. The printed surface of the paper dries relatively slowly and can be smeared during subsequent processing, particularly when the printed sheets are stacked. In order to minimize smearing, a dryer may be mounted along the delivery path of the printed sheets, or an anti-offset spray powder may be sprayed on the printed surface.

In some printing applications, it is desirable that the press be capable of applying a protective and/or decorative coating over all or a portion of the surface of the printed sheets. Typical coating solutions include varnish, lacquer, dye, moisturizers and ink. Such coatings typically are formed of a UV-curable or water-soluble resin applied as a liquid solution or emulsion by an applicator roller over the freshly printed sheets to protect the ink and improve the appearance of the sheets. Use of such coatings is particularly desirable when decorative or protective finishes are required such as in the production of posters, record jackets, brochures, magazines, folding cartons and the like. In cases where a liquid coating is to be applied, the coating operation is carried out after the final ink printing has been performed, most desirably by an in-line coating application.

DESCRIPTION OF THE PRIOR ART

Various suggestions have been made for applying the coating as an in-line press operation by using the final printing station of the press as the coating application station. For example, in U.S. Pat. Nos. 4,270,483, 4,685,414 and 4,779,557, there are disclosed coating apparatus which can be moved into position to allow the blanket cylinder of the last printing station of a press to be used to apply a coating material to the sheets. In U.S. Pat. No. 4,796,556, there is disclosed a coating apparatus which can be selectively moved between the blanket cylinder or the plate cylinder of the last printing station of the press so that the station can be used as a coating station for the press.

Suggestions for overcoming the problem of the loss of a printing station when coating is desired have also been made, such as that set forth in U.S. Pat. No. 4,934,305 which discloses a coating apparatus having a separate timed applicator roller positioned to apply the coating material to the printed sheet while the sheet is on the last impression cylinder of the press. This is said to allow the last printing station to be operated simultaneously as both an ink application station and a coating station so that no loss of press printing unit capability results. Another approach to providing a coating station without losing the printing capabilities of the last printing station is to provide a totally separate coating unit downstream of the last printing station so that the coating is applied to the sheets after final printing and before the sheets have reached the sheet delivery stacker. Such an approach is suggested in U.S. Pat. Nos. 4,399,767 and 4,706,601.

Conventional coating apparatus which is operable as an in-line press operation utilizes an engraved transfer roller, with the liquid coating being applied to the engraved roller by means of a doctor blade assembly. The doctor blade assembly includes an elongated housing having a reservoir chamber extending the length of the transfer roller for holding a volume of coating liquid in wetting contact with the circumferential surface of the transfer roller. A pair of circumferentially spaced doctor blades extend longitudinally along the reservoir housing on either side of the chamber. The doctor blades are angled tangentially toward the transfer roller surface, and seal the reservoir chamber against the roller surface and wipe the roller surface to deposit liquid in the cells of the engraved transfer surface.

The reservoir chamber is pressurized with coating liquid, which is pumped from a remote supply drum into the upper region of the pressure chamber. After the pressure chamber fills to a certain level, it is returned to the remote drum by gravity flow. Occasionally, the doctor blade reservoir chamber becomes completely filled with the coating liquid when the volume of coating liquid being delivered to the doctor blade reservoir chamber exceeds the gravity flow return rate. The positive pressure may cause the seals at the ends of the roller to leak, allowing the coating liquid to drip onto the floor or onto adjacent press parts. Occasionally, the coating liquid may be slung from the roller onto adjacent press equipment and operator areas. Moreover, the buildup of positive pressure within the doctor blade reservoir chamber accelerates the wear of the end seals.

It will be appreciated that the transfer roller may be operated at high speeds, for example, on the order of

1,000 linear feet per minute, and that the end seals of the doctor blade assembly will tend to wear quickly. The end seal wear is accelerated by the buildup of positive pressure within the doctor blade chamber. Low volume drip leakage can be collected in a drip pan or catch tray, but as the end seals wear, the coating liquid will be slung from the transfer roller, thereby causing a difficult cleanup problem. When this occurs, the press must be shut down, the doctor blade head must be removed, and the end seals replaced. The steps of rebuilding or replacing the end seals and realigning the doctor blade head causes an unacceptable amount of press downtime.

One approach for overcoming the problem of end seal wear is to provide stationary end seals which are mounted on the press frame, and which bear in sealing engagement against the ends of the transfer roller, so that the doctor blade head may form a seal with stationary seals rather than with the dynamic seals carried on the transfer roller. Another approach is to use rotary end seals which include an end plate which is resiliently engaged against the end surface of the transfer roller, with a seal member being secured between the end plate and the end portions of the roller by quick removal mounting lugs.

While the foregoing mechanical approaches to limiting end seal wear and thereby avoiding leakage have been moderately successful, and some arrangements have reduced downtime by quick change mounting features, the end seals nevertheless are still experiencing accelerated wear and early failure, thereby causing frequent replacements and unacceptable downtime for correction of end seal leakage.

OBJECTS OF THE INVENTION

Accordingly, there exists a need for a new and improved in-line coating apparatus for use in a sheet-fed or web-fed, offset rotary or flexographic printing press for applying a protective and/or decorative coating to the printed surface of freshly printed sheets which does not require any expensive or substantial press modification or result in any impairment of normal press operating capability.

Specifically, the principal object of the present invention is to provide a new and improved in-line coating and/or inking apparatus of the character described which achieves a reduction in end seal leakage.

SUMMARY OF THE INVENTION

The present invention provides a new and improved in-line doctor blade apparatus for applying a protective and/or decorative coating and/or inking to the surface of freshly printed sheets in a sheet-fed or web-fed, offset rotary or flexographic printing press which is highly reliable and effective in use, yet which does not require any expensive or substantial press modification or result in any impairment of normal press operating capability.

The reservoir of a doctor blade head is supplied with coating material from a remote supply drum. To insure that an adequate supply of coating liquid is always present within the doctor blade reservoir, the coating material is drawn from the remote supply drum and is circulated by suction flow constantly through the reservoir. In contrast to the conventional approach of positively pressurizing the doctor blade reservoir with liquid coating pumped from the remote drum to the reservoir, the coating material is instead circulated through the reservoir by suction flow. That is, instead of charging the reservoir with coating liquid pumped from the remote drum and thereby creating a positive pressure condition within the doctor blade reservoir, circulation through the reservoir is induced by suction flow provided by a suction pump having an input connected for drawing coating liquid from the doctor blade reservoir, and returning it by forced (positive pressure) flow to the remote supply drum, rather than by gravity flow return.

As a result of the suction flow arrangement, the liquid material is drawn from the remote supply drum at a greater rate than the rate of withdrawal of the liquid material by the pickup roller, and a substantially constant supply of liquid material will always be present within the doctor blade reservoir. A benefit of the suction flow arrangement is that a positive pressure buildup does not occur within the doctor blade chamber. Moreover, liquid material which rises above a predetermined fill level is drawn out of the doctor blade reservoir by the suction pump, and is returned to the remote drum. Consequently, the end seals are not subjected to high pressure differential conditions. Instead, the suction flow arrangement produces a negative pressure differential, with the doctor blade chamber being operated at a level below atmospheric. Under negative pressure conditions, leakage of coating liquid is virtually nonexistent, and the operating life of the end seals is substantially increased.

According to another aspect of the present invention, visual and audible alerts are provided by a vacuum sensor line which is coupled to the vacuum space within the doctor blade chamber. The sensor line is coupled to a vacuum gauge which provides a visual indication of the suction pressure within the doctor blade chamber. A vacuum sensor switch is also coupled to the chamber for selectively applying electrical power to an audio transducer when the pressure within the vacuum chamber rises above a predetermined safe operating suction level.

Other features and advantages of the present invention will become more apparent from the following detailed description taken in conjunction with the accompanying drawings which disclose, by way of example, the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic side elevational view of a sheet-fed, offset rotary printing press having a coating apparatus embodying the present invention;

FIG. 2 is an enlarged fragmentary side elevational view taken substantially within the circular area designated "2" in FIG. 1 and showing the coating apparatus of the present invention during coating operation;

FIG. 3 is an enlarged fragmentary perspective view showing one side of the coating apparatus mounted in the press and illustrating the fluid path of coating material from a remote supply drum to the doctor blade reservoir of the coating unit;

FIG. 4 is an enlarged fragmentary sectional view taken substantially along the line 4—4 of FIG. 3;

FIG. 5 is a simplified flow diagram which illustrates a dual pump arrangement for circulating coating liquid from a remote supply drum to the doctor blade reservoir and return;

FIG. 6 is a simplified flow diagram which illustrates a single pump arrangement for circulating coating liquid by suction flow from a remote supply drum to the doctor blade reservoir and return;

FIG. 7 is an enlarged fragmentary perspective view of one end portion of the doctor blade coating apparatus of the present invention;

FIG. 8 is an enlarged sectional view taken substantially along the line 8—8 of FIG. 7; and,

FIG. 9 is a view similar to FIG. 8 which includes a suction pressure sensing circuit for providing a visual indication of suction pressure and an audible alert when the suction/vacuum pressure inside the doctor blade rises above a safe operating level, thereby signaling an impending end seal failure.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

As shown in the exemplary drawings, the present invention is embodied in a new and improved in-line doctor blade apparatus, herein generally designated 10, for use in applying a protective and/or decorative coating or inks to the freshly printed surface of sheets printed in a sheet-fed or web-fed, offset rotary or flexographic printing press, herein generally designated 12. In this instance, as shown in FIG. 1, the doctor blade coating apparatus 10 is illustrated as installed in a four color printing press 12, such as that manufactured by Heidelberger Druckmaschinen AG of the Federal Republic of Germany under its designation Heidelberg Speedmaster 102V (40"), and which includes a press frame 14 coupled at one end, herein the right end, with a sheet feeder 16 from which sheets, herein designated 18, are individually and sequentially fed into the press, and at the opposite end, with a sheet delivery stacker 20 in which the finally printed sheets are collected and stacked. Interposed between the sheet feeder 16 and the sheet delivery stacker 20 are four substantially identical sheet printing stations 22, 24, 26 and 28 which can print different color inks onto the sheets as they are moved through the press 10.

As illustrated, each of the printing stations 22, 24, 26 and 28 is substantially identical and of conventional design, herein including a sheet-fed cylinder 30, a plate cylinder 32, a blanket cylinder 34 and an impression cylinder 36, with each of the first three printing stations 22, 24 and 26 having a transfer cylinder 38 disposed to withdraw the freshly printed sheets from the adjacent impression cylinder and transfer the freshly printed sheets to the next printing station via a transfer drum 40. The final printing station 28 herein is shown as equipped with a delivery cylinder 42 which functions to support the printed sheet 18 as it is moved from the final impression cylinder 36 by a delivery conveyor system, generally designated 44, to the sheet delivery stacker 20.

The delivery conveyor system 44 as shown in FIG. 2 is of conventional design and includes a pair of endless delivery gripper chains 46, only one of which is shown carrying at regular spaced locations along the chains, laterally disposed gripper bars 48 having gripper elements 50 used to grip the leading edge of a sheet 18 after it leaves the nip between the delivery cylinder 42 and impression cylinder 36 of the last printing station 28. As the leading edge E of the sheet 18 is gripped by the grippers 50, the delivery chains 46 pull the sheet away from the impression cylinder 36 and convey the freshly printed sheet to the sheet delivery stacker 20 where the grippers release the finally printed sheet.

The endless delivery chains 46 are driven in synchronous timed relation to the impression cylinder 36 by sprocket wheels 52 fixed adjacent the lateral ends of a delivery drive shaft 54 which has a mechanically geared coupling (not shown) to the press drive system. The delivery drive shaft 54 extends laterally between the sides of the press frame 14 adjacent the impression cylinder 36 of the last printing station 28, and is disposed to be parallel with the axis of the impression cylinder. In this instance, the delivery cylinder 42, which is constructed to allow adjustments in diameter by suitable means, is attached to the delivery drive shaft 54 so that the delivery cylinder is also rotated in precise timed relation with the impression cylinder.

In this respect, it is important to note that when the freshly printed sheets 18 are conveyed away from the impression cylinder 36 of the final printing station 28 by the gripper 50 carried by the delivery chains 46, the wet inked surfaces of the sheets face the delivery drive shaft 54 and the sheets must be supported such that the ink is not smeared as the sheets are transferred. Typically, such support is provided by skeleton wheels or cylinders mounted to the press delivery drive shaft 54, or as is now more commonly used, net equipped delivery cylinders marketed by Printing Research, Inc. of Dallas, Tex. under its registered trademark SUPERBLUE. That system, which is made and sold under license, is manufactured in accordance with and operates as described in U.S. Pat. No. 4,402,267, issued Sep. 6, 1983, to Howard W. DeMoore, the disclosure of which is incorporated herein by this reference.

More recently, vacuum transfer apparatus of the type disclosed in co-pending application Ser. No. 07/630,308, filed Dec. 18, 1990, entitled "Vacuum Transfer Apparatus for Sheet-Fed Printing Presses", which is also incorporated herein by reference, has been used. The vacuum transfer apparatus disclosed in that application can be used in place of delivery cylinders or skeleton wheels to pull the unprinted side of the sheet away from the delivery drive shaft 54 so that the wet ink surface of the sheets do not come into contact with any press apparatus.

In accordance with the present invention, the in-line doctor blade coating apparatus 10 for applying the protective or decorative coating or ink to the sheets 18 enables the press 12 to be operated in the normal manner without the loss of the final printing station 28, and without requiring any substantial press modifications by employing the existing press delivery drive shaft 54 as the mounting location for the coating applicator roller. In presses having delivery systems such as skeleton wheels mounted on the delivery drive shaft 54 or a vacuum transfer apparatus as disclosed in the aforementioned co-pending application Ser. No. 07/630,308, conversion to a coating operation can be quickly and easily achieved by mounting on the press delivery drive shaft in place of the skeleton wheels or in addition to the vacuum transfer apparatus, a suitable support cylinder capable of performing the combined function of a coating applicator roller and a net enhanced delivery cylinder 42. By utilizing the delivery cylinder 42 mounted on the delivery drive shaft 54 to also act as a coating applicator roller, protective coating will be applied to the printed sheet 18 in precise timed registration, and will permit the press to be operated with its full range of printing stations.

Toward these ends, the coating apparatus 10 of the present invention includes a relatively simple, positive acting and economical doctor blade coating unit, generally designated 60, mounted to the press frame 14 downstream of the delivery drive shaft 54 and positioned to apply liquid coating material to the support surface of a

delivery cylinder 42 mounted on the delivery drive shaft. As can best be seen in FIGS. 2, 3 and 4, the doctor blade coating unit 60 herein comprises a pair of side frames 62, only one of which is shown, it being understood that the other side frame is substantially the same as that of the side frame illustrated, attached to each side of the press frame 14. Pivotally mounted to one end of each of the side frames 62 is a support bracket 64 carrying one end of a liquid material reservoir 66 and cooperating liquid material pickup roller 68 each disposed to extend laterally across the press 12 parallel with the delivery drive shaft 54. The coating unit 60 is mounted between the upper and lower runs of the delivery chains 46 downstream of the delivery drive shaft 54, and positioned so that the outer peripheral surface 70 of the pickup roller 68 can be engaged with the support surface of a delivery cylinder 42 mounted on the delivery drive shaft.

As best seen in FIGS. 2 and 3, the support bracket 64 is pivotally attached to the end of the side frame 62 by a shaft 72 disposed at the lower end portion of the bracket, and can be pivoted about the shaft by an extensible cylinder 74, herein shown as a pneumatic cylinder, one end 76 of which is secured such as by welding to the side frame, and the opposite end 78 of which is coupled through a pivot shaft 79 to the upper end portion of the bracket. By extending or retracting the cylinder 74, the extent of engagement of the pickup roller 68 against the surface of the applicator roller 42 can be controlled, and the pickup roller can be completely disengaged from the applicator roller 42.

The coating pickup roller 68, which is of conventional design and preferably one such as the Anilox rollers manufactured by A.R.C. International of Charlotte, N.C. and sold under the name "PRINTMASTER" having an engraved ceramic or chrome outer peripheral surface 70, is designed to pick up a predetermined uniform thickness of liquid coating material or ink from the reservoir 66, and then uniformly transfer the coating material to the support surface of the applicator roller 42. To effect rotation of the pickup roller 68, a suitable motor 80, herein a hydraulic motor, is attached to one of the side frames 62 and coupled to a suitable hydraulic fluid source (not shown) through fittings 81A, 81B. Attached to the output of the motor 80 is an output gear which is drivingly coupled through a cluster gear 82 and a series of idler gears 83 each mounted on stub axles 84, to a drive gear 86 attached to the end of a shaft 88 on which the pickup roller 68 is concentrically mounted. The shaft 88 of the pickup roller 68 is, in turn, journaled at each end to the brackets 64 through a releasable semicircular collar 90 attached by bolts 92 to the bracket. Herein, the axle of the terminal idler gear, designated 83', also serves as the shaft 72 for pivotally mounting the support bracket 64 to the side frame 62 so that when the bracket is rotated about the shaft, the terminal idler gear remains engaged with the drive gear 86 of the pickup roller 68.

In this instance, as can best be seen in FIG. 4, the pickup roller 68 has a peripheral surface portion 68P which projects radially into the reservoir 66 containing the supply of coating material or ink. A pair of upper and lower inclined doctor blades 94 and 96 attached to the doctor blade head 98 on shoulders 98A, 98B engage the roller surface to doctor the excess liquid coating material or ink picked up from the reservoir by the engraved surface 70 of the roller. The reservoir cavity 66 herein is formed within an elongated doctor blade head 98 having a generally C-shaped cross-section with an opening 100 extending longitudinally along one side facing the pickup roller 68 The reservoir 66 is supplied with liquid material or ink from a supply drum 102 disposed in a remote location within or near the press 12. Preferably, the doctor blade head 98 is removably attached to the brackets 64, herein by bolts 104 having enlarged, knurled heads 106, and which can be threaded through slots 108 formed in the brackets to clamp the reservoir in place on the brackets.

To insure that an adequate supply of liquid coating material is always present within the reservoir 66 and to prevent coagulation and clogging of the doctor blades 94 and 96 by the liquid coating material or ink, the coating material or ink is circulated through the reservoir by two pumps 110 and 112 as shown in FIG. 5. Pump 110 draws the liquid material L from the supply drum 102 via a supply line 114 and discharges it into a bottom region of the reservoir 66 through a delivery port 114P, and the other pump 112 acts to provide suction to a pair of return lines 116A, 116B coupled adjacent a top region of the reservoir through return ports 116P, 116Q for withdrawing excess liquid coating material or ink from the reservoir. By supplying the coating material or ink from the supply drum 102 at a greater rate than the rate of withdrawal of material by the pickup roller 68, a substantially constant supply of coating material or ink will always be present within the reservoir 66. The excess coating material or ink which rises above the liquid level of the return port R (FIG. 8) is suctioned away by the suction return pump 112.

The general arrangement of the pickup roller 68, doctor blades 94 and 96, and reservoir 66 is similar to that disclosed in U.S. Pat. No. 4,821,672 entitled "Doctor Blade Assembly With Rotary End Seals and Interchangeable Heads", the disclosure of which provides details concerning the end seal structure and operation of a pickup roller and reservoir usable with the present invention. According to an important feature of the present invention, however, the doctor blade reservoir 66 is not pressurized as taught by the prior art. Instead, coating liquid or ink is supplied to the doctor blade reservoir 66 by the suction flow produced by the pump 112. In this arrangement, the suction pump 112 applies a vacuum or suction force in the reservoir which draws liquid material L from the supply through the supply conduit 114 to the reservoir and draws excess liquid material L from the doctor blade reservoir 66 through the return conduit 116 into the remote reservoir 102 at a rate which is greater than the rate that liquid coating material or ink is being supplied to the doctor blade reservoir through the supply conduit 114. Because the suction return flow rate is greater than the supply flow rate, a positive pressure condition within the doctor blade reservoir is avoided, and a below atmospheric vacuum pressure level is provided.

Referring to FIG. 5, FIG. 6, FIG. 7 and FIG. 8, the liquid material is delivered into the lower region of the doctor blade reservoir 66, and is withdrawn from the doctor blade reservoir near an upper region of the chamber through the return conduits 116A, 116B. The liquid level elevation of the return port is preferably selected to provide for the accumulation of liquid coating material or ink in more than about half of the doctor blade chamber, thereby insuring that the engraved surface of the pickup roller 68 will be thoroughly wetted by the coating material or ink L as it turns through the doctor blade chamber 66. The reservoir 66 is bounded

vertically by lower and upper doctor head shoulders 98A, 98B. Accordingly, the return ports 116P, 116Q of return lines 116A, 116B are located at a liquid level R intermediate the limits established by the lower and upper shoulders. Any excess liquid coating material or ink which rises above the liquid level R of the return ports will be suctioned away by the pump 112.

It will be appreciated that the supply pump 110 is optional, and that the suction circulation system can be operated effectively with only the single suction pump 112 as shown in FIG. 6. In the single pump configuration, it may be necessary to prime the supply conduit 114 to obtain satisfactory operation. The two pump arrangement as shown in FIG. 5 is preferred for those installations in which the supply drum 102 is located at a distance that is too far from the press to achieve adequate suction flow. The auxiliary supply pump 110 provides positive flow input to the doctor blade reservoir at a fixed flow rate. The return suction pump 112 has a faster suction flow rate than the supply flow rate. Consequently, a positive pressure buildup in the doctor blade reservoir cannot occur. By utilizing two pumps as shown in FIG. 5, the liquid level within the doctor blade chamber 66 can be closely controlled, without positive pressure buildup, thereby reducing leakage through the end seals.

Referring to FIG. 8, it will be appreciated that the doctor blade chamber 66 is maintained at a pressure level below atmospheric by the suction action of the return flow pump 112. The coating liquid L rises to the liquid level of the return port R and is drawn off immediately by the suction pump 112. Additionally, air within the doctor blade chamber 66 is also evacuated, thereby reducing the doctor blade chamber pressure to a level below atmospheric. This negative pressure differential condition opposes leakage of coating liquid L through the end seals. Since the doctor blade chamber 66 is not positively pressurized, the end seals are operated under favorable pressure differential conditions, thereby extending their useful lifetime. Moreover, the negative pressure differential doctor blade assembly will accommodate a pickup roller having a chipped corner, which would leak under positive pressure conditions, but does not leak because of the negative pressure reservoir condition established by suction flow.

It is useful for the press operator to have an advance warning of an impending end seal failure. With advance warning, the press operator can schedule repair and/or replacement of the doctor blades and the end seals at a convenient time, for example between press runs or before undertaking the next printing job. Apparatus for monitoring the suction/vacuum condition within the doctor blade chamber 66 is provided by a pneumatic sensor circuit 120 as shown in FIG. 9. The pneumatic sensor circuit 120 includes a pneumatic sensor line 122 which is coupled in fluid communication with the doctor blade chamber 66 through a vacuum sensor bore 124 formed through the upper doctor head shoulder 98B. The vacuum sensor line 122 is coupled to the sensor bore 124 by a threaded fitting 126.

Continuous monitoring of the vacuum/suction condition within the doctor blade chamber 66 is provided by a vacuum gauge 128 which can be of any conventional design, for example a Bourdon gauge which is calibrated for dry air and covers the range from about zero to about twenty torrs. The vacuum gauge 128 is coupled into the sensor line 122 by a tee coupling 130. According to this arrangement, the press operator receives a continuous visual indication of the vacuum/-suction condition within the doctor blade chamber 66.

According to another feature of the invention, the vacuum/suction line 122 is coupled to a vacuum switch 132. The vacuum switch 132 has a conductive, movable diaphragm 134 which moves into and out of electrical contact with switch electrodes 132A, 132B. That is, the diaphragm 134 is pulled out of contacting engagement with the switch electrodes 132A, 132B when the vacuum/suction level in the doctor blade chamber 66 is below a predetermined level. When the pressure level within the doctor blade chamber 66 rises above that preset level, for example in response to leakage of air through the end seals or around a worn doctor blade 94, the vacuum force within the vacuum chamber 132C of the sensor switch also rises, thereby permitting the conductive switch element 134 to engage the switch electrodes 132A, 132B.

When switch closure occurs, electrical power is applied to an audio transducer 136 from a power source 138. Electrical current is conducted through the pneumatic switch 132 to the audio transducer 136 through power conductors 140, 142. According to this arrangement, the press operator will receive an audible alert as soon as the suction/vacuum pressure in the doctor blade chamber rises above a safe operating level, thereby signaling wear failure of the doctor blades and-/or an impending failure of the end seals.

From the foregoing, it should be apparent that the coating apparatus 10 of the present invention provides a highly reliable, effective and economical in-line apparatus for applying coating material to the freshly printed sheets 18 in a sheet-fed, offset rotary printing press 12 which allows the final printing station to continue to be used as a print station, yet which does not require any substantial press modification or the addition of a separate timed applicator roller. While a particular form of the present invention has been illustrated and described, it should be apparent that variations and modifications therein can be made without departing from the spirit and scope of the invention.

What is claimed is:

1. Coating apparatus for applying liquid material from a supply drum to an applicator roller which is engagable in an operative position with a doctor blade head having an elongated reservoir for receiving liquid material from the supply drum, said doctor blade head being adapted to extend in parallel with the applicator roller in the operative position with a portion of the peripheral surface of the applicator roller extending into said reservoir for wetting contact with liquid material contained therein, characterized in that:

seal means are coupled to the doctor blade head for sealing engagement against the applicator roller in the operative position, whereby the doctor reservoir is sealed with respect to atmospheric pressure; and,

circulation means are coupled to the doctor reservoir for inducing the flow of liquid material from said supply drum into the doctor reservoir, for returning liquid material by suction flow from the doctor reservoir to the supply drum, and for maintaining the doctor reservoir at a pressure level below atmospheric pressure.

2. Coating apparatus as defined in claim 1, said circulation means being characterized by

a supply conduit connecting the supply drum in flow communication with the doctor reservoir;

a return conduit connecting the doctor reservoir in flow communication with the supply drum; and,

a first pump coupled in series flow relation with the return conduit for inducing suction flow of liquid material from the doctor reservoir through the return conduit into the supply drum.

3. Coating apparatus as defined in claim 2, characterized in that the return conduit is coupled in flow communication with the doctor reservoir at a first liquid level location and the supply conduit is coupled in flow communication with the doctor reservoir at a second liquid level location, the first liquid level location of the return conduit being higher in elevation than the second liquid level location of the supply conduit when the doctor blade head is in the operative position.

4. Coating apparatus as defined in claim 1, said circulation means being characterized by:

a second pump coupled in series flow relation with said supply conduit for pumping liquid material from the supply drum to the doctor reservoir.

5. Coating apparatus as defined in claim 4, characterized in that the suction return flow rate provided by said first pump is greater than the supply flow rate provided by said second pump.

6. Coating apparatus as defined in claim 1, wherein the doctor blade head having first and second shoulders forming lower and upper liquid level boundaries for said reservoir, respectively, characterized in that said circulation means includes a return conduit coupled in flow communication with said reservoir at a liquid level location disposed intermediate the liquid level boundaries established by said first and second shoulders.

7. Coating apparatus as defined in claim 1, characterized in that a pneumatic conduit is coupled to the doctor reservoir for sensing air vacuum pressure within the doctor reservoir, and a vacuum gauge is coupled to the pneumatic conduit for providing a visual indication of air vacuum pressure in the doctor reservoir.

8. Coating apparatus as defined in claim 1, characterized in that a pneumatic conduit is coupled to the doctor reservoir for sensing air vacuum pressure within the doctor reservoir, a vacuum responsive switch having switch electrodes is coupled to said pneumatic sensor conduit, and an audio transducer is electrically connected to the switch electrodes for making and breaking an electrical circuit from a power source to said audio transducer.

9. Coating apparatus as defined in claim 1, characterized in that means are coupled to the doctor reservoir for supplying and evacuating liquid material to and from the doctor reservoir at differential flow rates, respectively, whereby a lower chamber region of the doctor reservoir is maintained in a filled condition and an upper chamber region of the reservoir is maintained in an evacuated condition.

10. Coating apparatus for applying liquid material from a supply drum to an applicator roller which is engagable in an operative position with a doctor blade head having an elongated reservoir for receiving liquid material from the supply drum, said doctor blade head being adapted to extend in parallel with the applicator roller in the operative position with a portion of the peripheral surface of the applicator roller extending into said reservoir for wetting contact with liquid material contained therein, and including doctor blade means attached to the doctor blade head for engagement against the peripheral surface of the applicator roller in the operative position, characterized in that:

circulation means are coupled to the doctor reservoir for inducing the flow of liquid material from said supply drum into the doctor reservoir and for returning liquid material by suction flow from the doctor reservoir to the supply drum; and

means are provided for mounting the coating apparatus on the side frame of a printing press adjacent to a transfer delivery cylinder, a liquid material coating blanket is secured to the transfer delivery cylinder, and including means for extending the applicator roller into engagement with the coating blanket in the operative position and for retracting the applicator roller out of engagement with the coating blanket in an idle position.

* * * * *

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Printing Research, Inc.
"Mark-less" Super Blue®

June 25, 1993

Mr. Bill Davis
Williamson Printing
PO Box 36622
6700 Denton Drive
Dallas TX 75235

214-904-2100 (Phone)

Dear Bill,

It was a great pleasure meeting with you and Bob Emrick. We have enclosed product information and the following **Super Blue** proposal for installation on your:

Package 1 A. **Komori Lithrone**, 6 color, 40 inch press
B. **Komori Lithrone**, 6 color, 40 inch press
C. **OMCSA**, 6 color, 40 inch press
D. **OMCSA**, 5 color, 40 inch press

- A **Super Blue** anti-marking system for installation at each of the wet transfers.

Package 2 A, B, C & D presses as above
A & B
- A **Super Blue** anti-marking system for installation at the wet transfers.
- A **Super Blue** BV BacVac Delivery Vacuum Transfer System for installation at the delivery transfer.

C & D
- A **Super Blue** anti-marking system for installation at the wet transfers.

Package 3 **Komori Lithrone**, 6 color, 40 inch press
- A **Super Blue** PBC Plate/Blanket Coater for installation at the last printing unit.
- A **Super Blue** CII Combination II 2KW Air Knives and Exhaust Infra-Red Drying System for installation in the delivery.
- A **Super Blue** CUV 'Cold' UV Drying System for installation in the delivery.
- A **Super Blue** Vent-A-Hood System for installation on the delivery.
- A **Super Blue** HV High Velocity Hot Air Drying System for installation between printing units.

Package 4 **OMCSA**, 2 color, 40 inch press

- A **Super Blue** PBC Plate/Blanket Coater on printing units one and for installation at the last printing unit.
- A **Super Blue** BV BacVac Delivery Vacuum Transfer System for installation between printing units and at the delivery transfer.
- A **Super Blue** HV High Velocity Hot Air Drying System for installation between printing units and in the delivery.
- A **Super Blue** CUV 'Cold' UV Drying System for installation in the delivery.
- A **Super Blue** Vent-A-Hood System for installation on the delivery.

Package 5 **Komori Lithrone**, 6 color, 40 inch press

- A **Super Blue** HV High Velocity Hot Air Drying System for installation between printing units.

We look forward to serving your needs and thank you for your interest in our **Super Blue** range of products.

Sincerely yours,

John

John Bird
Product Manager

JB:nw

Enclosure

cc: Bob Emrick - Williamson Printing
Steve Baker

Printing Research, Inc.
"Mark-less" Super Blue®

Williamson Printung
June 25, 1993

SUMMARY OF PROPOSAL
for
PACKAGE 1

QTY	EQUIPMENT	UNIT PRICE	EXTENSION
	A. KOMORI LITHRONE 6 COLOR, 40 INCH		
6	SUPER BLUE DOUBLE SIZE TRANSFER/DELIVERY KITS	$ 1,100.	$ 6,600.
	B. KOMORI LITHRONE 6 COLOR, 40 INCH		
6	SUPER BLUE DOUBLE SIZE TRANSFER/DELIVERY KITS	1,100.	6,600.
	C. OMCSA 6 COLOR, 40 INCH		
8	SUPER BLUE DOUBLE SIZE TRANSFER/DELIVERY KITS	1,100.	8,800.
	D. OMCSA 5 COLOR, 40 INCH		
6	SUPER BLUE DOUBLE SIZE TRANSFER/DELIVERY KITS	1,100.	6,600.
	TOTAL EQUIPMENT (FOB Factory)		$28,600.

FREIGHT PREPAID AND ADDED TO INVOICE, INSTALLATION AND TRAINING CHARGED AT $575. PER DAY PER MAN PLUS AIRFARES

QTY	RECOMMENDED SPARE PARTS	UNIT PRICE	EXTENSION
1	NONE REQUIRED		

PROPOSAL, TERMS AND CONDITIONS OF SALE ON REVERSE SIDE ACCEPTED BY:

NAME ____________________

TITLE ____________________

SIGNATURE ____________________

DATE ____________________

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W001085

Printing Research, Inc.
"Mark-less" Super Blue*

SB 093988
Williamson Printing
June 25, 1993

PROPOSAL

SUPER BLUE ANTI-MARKING SYSTEM
PACKAGE 1

QTY	EQUIPMENT		UNIT PRICE	EXTENTION
	A. KOMORI LITHRONE, 6 COLOR, 40 INCH			
6	Double Size Transfer/Delivery Kits	@	$1,100.	$ 6,600.
	B. KOMORI LITHRONE, 6 COLOR, 40 INCH			
6	Double Size Transfer/Delivery Kits	@	$1,100.	$ 6,600.
	C. OMCSA, 6 COLOR, 40 INCH			
8	Double Size Transfer/Delivery Kits	@	$1,100.	$ 8,800.
	D. OMCSA, 5 COLOR, 40 INCH			
6	Double Size Transfer/Delivery Kits	@	$1,100.	$ 6,600.
	TRAINING AND INSTALLATION: (PER MAN/PER DAY PLUS AIRFARE)			$ 575.

Training and installation prices are based on performing work between 6:00 am and 6:00 pm. Work scheduled to begin other than between those times or on weekends is subject to a premium charge above the quoted price for training and installation.

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PAYMENT TERMS AND/OR SPECIAL NOTATIONS:

30-day money back guarantee when training and installation is provided by Printing Research, Inc.

Terms are 1/3 prior to shipment, balance due in two equal payments 30 and 60 days after shipment with approved credit. Extended payment Program available to qualified participants offering below-market interest rate.

Prices and terms quoted above are valid for 60 days from the date of quotation. Pricing in this quote supersedes any previous quote you may have received. All prices are FOB Dallas, TX.

We will be happy to proceed immediately upon receipt of your approval.

W001086

10954 Shady Trail Dallas, Texas 75220 U.S.A. Telephone 214-353-9000 Telex 794028 Superblue dal Fax 214-357-5847

Super Blue "Wash-Free" Anti-Marking System

FEATURES	ADVANTAGES	BENEFITS
○ Top grade machined aluminum delivery cylinder with frictionless cylinder surface to which is attached a movable ink and water repellant net covering preventing paper, water and ink from contacting with cylinder surface	○ Virtually eliminates all marking ○ Eliminates skeleton wheels and all associated systems, and adjustments i.e. star bars, bird cage arrangements ○ Skeleton wheel adjustments are no longer necessary ○ Avoids running oversized sheets for wheel placement ○ Full cylinder gives better support to printed sheet ○ Prevents re-stripping of jobs in order to have a place to run wheels ○ Eliminates the need to run a wheel in the center of the sheet ○ Press can be operated at maximum speeds ○ More creative in layout (allows nesting), with no limitations	○ Reduces paper waste and cost ○ Full ink coverage even on coated stock ○ Increased profitability and productivity ○ Non-stop production with optimum profits ○ Expanded customer base with paper savings
○ A frictionless base cover placed on transfer drums to which is attached a movable, ink and water repellant net covering preventing paper, water and ink from contacting with cylinder surface.	○ Virtually eliminates all marking ○ Reduces makeready ○ Eliminates all transfer drum washing ○ Aids in transferring difficult stock from unit to unit	○ Reduces paper waste and cost ○ Increased profitability and productivity ○ Increased print flexibility
○ Velcro mounting borders	○ Quick and simple net replacement	○ Minimized installation error
○ "Wash-free" nets and maintenance free base covers	○ Near perfect total maintenance free system	○ Increased productivity and profitability
○ Less than six month return on investment	○ Sales force can sell benefits of "Mark-less" printing	○ Excellent investment which yields more competitive pricing and expanded capabilities
○ Guaranteed to perform	○ 30 day money back guarantee ○ Endorsed by major press manufacturers ○ Over 100,000 cylinders sold	○ Risk free ○ Peace of mind
○ Complete training of staff by PRI professionals (Including complete Instructions)	○ Knowledgeable operators at completion of installation and training	○ Increased productivity due to responsive training program by PRI ○ Ability to produce saleable sheets immediately after training

W001087

Printing Research, Inc.
"Mark-less" Super Blue®

Williamson Printing
June 25, 1993

SUMMARY OF PROPOSAL
for
PACKAGE 2

QTY	EQUIPMENT	UNIT PRICE	EXTENSION
	A. KOMORI LITHRONE 6 COLOR, 40 INCH		
1	SUPER BLUE BACVAC VACUUM DELIVERY SYSTEM (BV)	$ 11,611.	$ 11,611.
5	SUPER BLUE DOUBLE SIZE TRANSFER KITS	1,100.	5,500.
	B. KOMORI LITHRONE 6 COLOR, 40 INCH		
1	SUPER BLUE BACVAC VACUUM DELIVERY SYSTEM (BV)	11,611.	11,611.
5	SUPER BLUE DOUBLE SIZE TRANSFER KITS	1,100.	5,500.
	C. OMCSA 6 COLOR, 40 INCH		
8	SUPER BLUE DOUBLE SIZE TRANSFER KITS	1,100.	8,800.
	D. OMCSA 5 COLOR, 40 INC		
6	SUPER BLUE DOUBLE SIZE TRANSFER KITS	1,100.	6,600.
	TOTAL EQUIPMENT (FOB Factory)		$49,622.

FREIGHT PREPAID AND ADDED TO INVOICE, INSTALLATION AND TRAINING CHARGED AT $575. PER DAY PER MAN PLUS AIRFARES

QTY	RECOMMENDED SPARE PARTS	UNIT PRICE	EXTENSION
1	NONE REQUIRED		

PROPOSAL, TERMS AND CONDITIONS OF SALE ON REVERSE SIDE ACCEPTED BY:

NAME ______________________

TITLE ______________________

SIGNATURE ______________________

DATE ______________________

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PROTECTIVE ORDER

W001088

10954 Shady Trail Dallas, Texas 75220 U.S.A. Telephone 214-353-9000 Telex 794028 Superblue dal Fax 214-357-5847

Printing Research, Inc.
"Mark-less" Super Blue*

SB 093988
Williamson Printing
June 25, 1993

PROPOSAL

SUPER BLUE ANTI-MARKING SYSTEM
PACKAGE 2

QTY	EQUIPMENT		UNIT PRICE	EXTENTION
	A. KOMORI LITHRONE, 6 COLOR, 40 INCH			
5	Double Size Transfer Kits	@	$ 1,100.	**$ 5,500.**
	B. KOMORI LITHRONE, 6 COLOR,40 INCH			
5	Double Size Transfer Kits	@	$ 1,100.	**$ 5,500.**
	C. OMCSA, 6 COLOR, 40 INCH			
8	Double Size Transfer Kits	@	$ 1,100.	**$ 8,800.**
	D. OMCSA, 5 COLOR, 40 INCH			
6	Double Size Transfer Kits	@	$ 1,000.	**$ 6,600.**
	TRAINING AND INSTALLATION: (PER MAN/PER DAY PLUS AIRFARE)			$ 575.

Training and installation prices are based on performing work between 6:00 am and 6:00 pm. Work scheduled to begin other than between those times or on weekends is subject to a premium charge above the quoted price for training and installation.

PAYMENT TERMS AND/OR SPECIAL NOTATIONS:

30-day money back guarantee when training and installation is provided by Printing Research, Inc.

Terms are 1/3 prior to shipment, balance due in two equal payments 30 and 60 days after shipment with approved credit. Extended payment Program available to qualified participants offering below-market interest rate.

Prices and terms quoted above are valid for 60 days from the date of quotation. Pricing in this quote supersedes any previous quote you may have received. All prices are FOB Dallas, TX. We will be happy to proceed immediately upon receipt of your approval.

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W001089

Super Blue "Wash-Free" Anti-Marking System

FEATURES	ADVANTAGES	BENEFITS
Top grade machined aluminum delivery cylinder with frictionless cylinder surface to which is attached a movable ink and water repellant net covering preventing paper, water and ink from contacting with cylinder surface	Virtually eliminates all marking	Reduces paper waste and cost
	Eliminates skeleton wheels and all associated systems, and adjustments i.e. star bars, bird cage arrangements	Full ink coverage even on coated stock
	Skeleton wheel adjustments are no longer necessary	Increased profitability and productivity
	Avoids running oversized sheets for wheel placement	
	Full cylinder gives better support to printed sheet	
	Prevents re-stripping of jobs in order to have a place to run wheels	
	Eliminates the need to run a wheel in the center of the sheet	
	Press can be operated at maximum speeds	Non-stop production with optimum profits
	More creative in layout (allows nesting), with no limitations	Expanded customer base with paper savings
A frictionless base cover placed on transfer drums to which is attached a movable, ink and water repellant net covering preventing paper, water and ink from contacting with cylinder surface.	Virtually eliminates all marking	Reduces paper waste and cost
	Reduces makeready	
	Eliminates all transfer drum washing	Increased profitability and productivity
	Aids in transferring difficult stock from unit to unit	Increased print flexibility
Velcro mounting borders	Quick and simple net replacement	Minimized installation error
"Wash-free" nets and maintenance free base covers	Near perfect total maintenance free system	Increased productivity and profitability
Less than six month return on investment	Sales force can sell benefits of "Mark-less" printing	Excellent investment which yields more competitive pricing and expanded capabilities
Guaranteed to perform	30 day money back guarantee	Risk free
	Endorsed by major press manufacturers	
	Over 100,000 cylinders sold	Peace of mind
Complete training of staff by PRI professionals	Knowledgeable operators at completion of installation and training	Increased productivity due to responsive training program by PRI
(Including complete Instructions)		Ability to produce saleable sheets immediately after training

Printing Research, Inc.
"Mark-less" Super Blue®

BV 093988
Williamson Printing
June 25, 1993

PROPOSAL

PACKAGE 2

SUPER BLUE BACVAC DELIVERY VACUUM TRANSFER SYSTEM

QTY	PRESS	PRICE
	A. KOMORI LITHRONE, 6 COLOR, 40 INCH	
1	BacVac Vacuum Delivery System	$ 11,611.
	B. KOMORI LITHRONE, 6 COLOR, 40 INCH	
1	BacVac Vacuum Delivery System	$ 11,611.

PURPOSE

- Optimized press speeds with minimal risk of marking varnish, water based or U.V. coatings.
- Stop unnecessary delivery wheel makeready.
- Eliminate starwheel and stop press adjustments.

APPLICATION

Paper, Card, Carton Board, Plastic, Foil

CONFIGURATION

A vacuum transfer system which eliminates marking completely for sheet fed presses. The press grippers pull the sheet, dry side against the BACVAC rollers, which are contoured to the original cylinder path. The vacuum holds the sheets against the rollers, ensuring that the printed and or coated side of the sheet does not come into contact with any surface whatsoever.

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Enclosures: Sales Terms
Features Table

W001091

10954 Shady Trail Dallas, Texas 75220 USA Telephone 214-353-9000 Telex 794028 Superblue dal Fax 214-357-5847

Super Blue BacVac

FEATURES	ADVANTAGES	BENEFITS
○ Vacuum Transfer System with frictionless free wheeling roller support	○ Assures markfree printed or coated sheets at delivery transfer	○ Optimized press speed assures higher productivity and profitability.
	○ Provides ability to print or coat any thickness or grain direction of stock.	○ Creates total flexibility in choice of stock
	○ Any stock adheres to vacuum transfer at full press speeds	○ Guaranteed quality of heavy ink coverage, varnished or coated work.
		○ Reduced spoilage and over runs
	○ Decreases need to purchase special stock	○ Provides added value to finished sheets
	○ Non-printed or non-coated side of sheet is held by vacuum to the contour of the BacVac rollers	○ Maximizes ink, varnish or coating applications without marking
	○ Printed or coated side of sheet does not make contact with any surface	○ Full coverage without scratching or marking.
	○ Fully automatic, maintenance free, no adjustments	○ Eliminates make ready down time at delivery transfer increasing productivity and profitability
	○ No special tools, no stop press adjustments, no delivery adjustments necessary	
○ Energy efficient vacuum motor	○ Continuous controlled air flow	○ Low cost energy consumption
○ Automatic on/off	○ No adjustments necessary	
○ Complete training of staff by PRI professionals	○ Knowledgeable operators at completion of installation and training	○ Increased productivity due to responsive training program by PRI
(Including complete Operator's and Pre-Installation Manuals)		○ Ability to produce saleable sheets immediately after training.

W001092

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Printing Research, Inc.
"Mark-less" Super Blue®

Williamson Printing
June 25, 1993

SUMMARY OF PROPOSAL
for
PACKAGE 3
KOMORI LITHRONE 6 / 40

	QTY	EQUIPMENT	UNIT PRICE	EXTENSION
A	1	SUPER BLUE PLATE BLANKET COATER (PBC)	$ 76,530.	$ 76,530.
B	1	SUPER BLUE COMBINATION II 2KW AIR KNIVES EXHAUST IR DRYER (CII)	30,770.	30,770.
C	1	SUPER BLUE THREE LAMP 'COLD' UV DRYING SYSTEM (CUV)	87,806.	87,806.
D	1	SUPER BLUE VENT-A-HOOD EXHAUST SYSTEM (VH)	4,000.	4,000.
E	1	SUPER BLUE HIGH VELOCITY HOT AIR DRYING SYSTEM (HV)	39,992.	39,992.
		TOTAL EQUIPMENT (FOB Factory)		$239,098.

FREIGHT PREPAID AND ADDED TO INVOICE. INSTALLATION AND TRAINING CHARGED AT $575. PER DAY PER MAN PLUS AIRFARES

	QTY	RECOMMENDED SPARE PARTS	UNIT PRICE	EXTENSION
A	1	SPARE APPLICATOR ROLL (per inch)	70.	$ 2,800.
	1	SPARE METERING ROLL (per inch)	45.	1,800.
B	1	SPARE BOX OF LAMPS (10 per box)	104.	1,040.
C	3	SPARE U.V. LAMPS	338.	1,014.
	2	FILTER TUBES	587.	1,174.
	3	DEIONIZING RESIN CARTRIDGES	50.	150.
D/E		NONE REQUIRED		
		TOTAL RECOMMENDED SPARE PARTS		$ 7,978.

PROPOSAL, TERMS AND CONDITIONS OF SALE ON REVERSE SIDE ACCEPTED BY:

NAME ____________________ CONFIDENTIAL SUBJECT TO PROTECTIVE ORDER

TITLE ____________________

W001093

SIGNATURE ____________________ DATE ____________________

10954 Shady Trail Dallas, Texas 75220 U S A Telephone 214-353-9000 Telex 794028 Superblue dal Fax 214-357-5847

Printing Research, Inc.
"Mark-less" Super Blue®

PBC 093988
Williamson Printing
June 25, 1993

PROPOSAL
PACKAGE 3

SUPER BLUE PBC PLATE AND BLANKET COATER

PRESS	COLOR/SIZE	PRICE
KOMORI LITHRONE	6 / 40	$ 76,530.

RECOMMENDED SPARE PARTS:

Spare Rolls:	Applicator (per inch)	$ 70.
	Metering (per inch)	$ 45.
Spare Pump Stand:	If intention is to run both aqueous and UV	$ 4,000.

PURPOSE

Application of aqueous or UV coatings to either the plate or blanket cylinder of a press unit, for spot or area coating with exceptional uniformity, clean edges and precise registration.

APPLICATION

Paper, Card, Carton Board, Corrugated, Plastic, Foil

CONFIGURATION

Speed control is maintained via throttling valves mounted on the control cabinet. Start/stop controls are interlocked with press controls to suit. All rolls are variable speed and are ramped to match the selected percentage of surface speed. Applicator roll normally drives slower than plate or blanket surface speed, while metering roll and pick up or pan roll are always less than the applicator. The applicator roll automatically follows the direction of the plate or blanket.

The metering and applicator rollers are rubber, while the pick up roll is chromed microfinished. The metering roll has left and right hand adjustments for on-off contact with pick-up roll and independent manual screw adjustments to set profile. Each roll has vernier indicators for gap adjustment. A stainless steel coater pan is designed for recirculation of coating via a diaphragm pump with a large diameter hose used to return the coating to a 55 gallon drum. The diaphragm pump is plumbed and is installed on a stainless steel coating drum cover incorporating a hinged plexiglass viewing window and an adjustable, audible, and visual warning system.

Enclosures: Sales Terms
Features Table

10954 Shady Trail Dallas, Texas 75220 U.S.A Telephone 214-353-9000 Telex 794028 Superblue dal Fax 214-357-5847

Super Blue PBC Plate Blanket Coater

FEATURES	ADVANTAGES	BENEFITS
○ Fully retractable Spot Plate or Blanket coating	○ Ability to spot or overall coat ○ In-line coating flexibility without dedicating the last printing unit to coating	○ Maximum utilization of printing units
○ Application of coating from plate cylinder	○ Elimination of lengthy downtime due to registering coating to image ○ Negates need to cut blankets while press down ○ Sharp clean, crisp image definition ○ Water-based coating can replace and surpass press varnish ○ Coatings have higher scuff resistance than press varnish and are non-yellowing	○ Simple precise register control ○ Increased productivity and profitability ○ Insurmountable quality ○ Value added to printed sheets ○ Increased product durability and cosmetic quality
○ Application of coating from blanket cylinder	○ Fast makeready since overall coating directly applied from blanket cylinder ○ Heavy overall coating film weights easily applied ○ Functional coatings such as remoistenable gum and blister pack coatings easily applied	○ Increased productivity and profitability ○ Optimizing gloss and physical properties ○ Added value to printed work and increased product range capabilities
○ Sheer application of coatings	○ Uniform thickness of coating from the plate cylinder ○ Minimizes slinging or misting of coatings ○ Allows the widest range of viscosities to be used ○ Water based coatings will stay open indefinitely on coater while circulating	○ The best coating lay characteristics for optimized added value ○ Prevents costly cleanups ○ Optimizes gloss and physical properties ○ Minimizes downtime through wash-ups, operators can concentrate on press operation creating higher productivity
○ Coating pump stand with run dry protection	○ Visual and audible warning of low coating level in barrel	○ Complete operator awareness alert and non-stop production
○ Complete training of staff by PRI professionals (Including complete Operator's and Pre-Installation Manuals)	○ Knowledgeable operators at completion of installation and training ○ Recommendation of all production consumables available for start-up.	○ Increased productivity due to responsive training program by PRI ○ Ability to produce saleable sheets immediately after training

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Printing Research, Inc.
"Mark-less" Super Blue®

CII 093988
Williamson Printing
June 25, 1993

PROPOSAL
PACKAGE 3

SUPER BLUE COMBINATION II 2KW AIR KNIVES/EXHAUST IR DRYER

PRESS	COLOR/SIZE	MAX KW OUTPUT	PRICE
KOMORI LITHRONE	6 / 40	48	$ 30,770.

RECOMMENDED SPARE PARTS:

2KW Lamps (10 lamps per box)	$ 1,040.

PURPOSE

Accelerates the drying of inks, reduces the need for spray powder, dries aqueous coatings on paper, card, corrugated and carton board.

CONFIGURATION

The unique Super Blue Combination II infra-red dryer is installed in the delivery of the press with 18 inch 2KW short wave infra-red lamps.The dryer is linked to impression of the press and automatically switches lamps off when the press is off impression and automatically switches lamps on when the press is on impression. The lamp ends are cooled with air which is ducted through airknives built into the dryer and a separate airknife is also supplied to drive moisture off the sheet surface. A separately supplied exhaust system ensures no build up of moisture within the drying area of the press. A water cooled reflector pan with a closed loop heat exchanger further protects the press and printed work. Standard control system including diagnostics and thermometer is supplied as a press mounting module.

Enclosures: Sales Terms
Features Table

10954 Shady Trail Dallas, Texas 75220 U.S.A Telephone 214-353-9000 Telex 794028 Superblue dal Fax 214-357-5847

Super Blue Combination II Air Knives/Exhaust Infra-Red Dryer

FEATURES	ADVANTAGES	BENEFITS
Combination of air knives/ exhaust and shortwave infra-red	Assures accelerated drying of ink Minimizes spray powder consumption Assures drying of water based coatings Most effective in driving moisture out of ink and coating High scrubbing action of air knives makes removal of moisture laden air easily achievable Will not dry out stock, will not shrink sheet, will not cause loss of register for 2nd pass or post press operations	Increases productivity and profitability Assures highest quality levels for value added
Unique 18 inch 2kw short wave infra-red lamps	Desired stack temperatures easily achieved on any stock at full press speeds 25% more energy output and 50% more dwell time than any other dryer Instantaneous on/off response - less than 1 second	Highest possible productivity Improve lay characteristics of coatings Maximum energy efficiency Optimizes energy efficiency Improved safety. Minimal chance of fire if sheet touches lamps
Lamp life rated at 5000 hours and are individually replaceable	Longer life, less maintenance	Cost effective, economical
Water cooled (closed loop) reflector plate	Prevents heat build-up of delivery pan No special plumbing needed	Assures controllable stack temperature for greater efficiency. Prevents damage to press mechanisms. Prevents metal fatigue
Complete training of staff by PRI professionals (Including compete Operator's and Pre-Installation Manuals)	Knowledgeable operators at completion of installation and training	Increased productivity due to responsive training program by PRI Ability to produce saleable sheets immediately after training

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SUBJECT TO
PROTECTIVE ORDER

Printing Research, Inc.
"Mark-less" Super Blue®

CUV 093988
Williamson Printing
June 25, 1993

PROPOSAL
PACKAGE 3

SUPER BLUE 'COLD' UV DRYING SYSTEM

PRESS	COLOR/SIZE	LAMPS	RATING	PRICE
KOMORI LITHRONE	6 / 40	3	300 watt/inch	$ 87,806.

RECOMMENDED SPARE PARTS:

UV Lamps (each)	$338.
Filter Tubes (each)	$587.
Deionizing Resin Cartridge (each)	$ 50.

PURPOSE

Curing (drying) UV inks, varnishes or coating on sheet or web fed presses.

APPLICATION

Paper, Card, Carton Board, Corrugated, Plastic, Foil

CONFIGURATION

Curing heads are linked to impression of press and automatically switch to standby mode when press is off impression for five minutes. If no further action is taken, then lamps automatically turn off; if the press is put back into impression, the lamps automatically return to full power.

Standard Control Unit contains all necessary switchgear and controls to provide individual lamp selection, full and reduced individual power switching, elapsed life meters, lamp indicators and emergency stop button.

Main power transformer, capacitor banks and closed loop exchanger plant are supplied as floor standing modules. Full safety interlock circuits are fitted throughout. Ozone and heat extraction from the press are not normally required.

Enclosures: Sales Terms
Features Table

10954 Shady Trail Dallas, Texas 75220 U S A Telephone 214-353-9000 Telex 794028 Superblue dal Fax 214-357-5847

SUPER BLUE 'COLD' UV DRYING SYSTEM

FEATURES	ADVANTAGES	BENEFITS
Quartz Filter Tubes carrying deionized distilled water	Allows 98-99% of the UV to pass through	Maximizes curing efficiency which results in full production press speeds
	Filters most of the unwanted heat	Minimizes risk of fire and resultant downtime
	Ensures low stack temperatures	Eliminates risk of distortion of heat sensitive stock
Closed Loop Deionizing chilled water system	Allows complete temperature control of water recirculation system	No costly losses of heating or cooling energy from the plant
Low Volume Compressed Air Lamp Cooling	Ensures minimal ozone production	Creates a safe work place environment meeting all OSHA and EPA standards
	Ensures lamp running temperatures are precise	Assures optimum efficiency level of UV output
Heat Exhaust System (HES) installed between printing units	Reduces heat build-up created by chemical reaction of inks	Eliminates expensive downtime caused by ink piling on the blankets
	Reduces tack levels of ink	Decreases risk of hickies and the cost of downtime to remove hickies on work and turn
	Prevents heat build-up between printing units	Protects press functions and operators
Water cooled UV lamp head and delivery reflector pan	Absorbs most of the unwanted heat	Prevents risk of press damage
	Prevents heat build-up of delivery stack	Eliminates risk of stock distortion in stack
		Decreases risk of waste sheets caused by offsetting of C2S stock when printed or coated first side
Complete Training of staff by PRI professionals (Including complete Operator's and Pre-Installation Manuals)	Knowledgeable operators at completion of installation and training	Increased productivity due to responsive training program by PRI
		Ability to produce saleable sheets immediately after training

Printing Research, Inc.
"Mark-less" Super Blue®

VH 093988
Williamson Printing
June 25, 1993

PROPOSAL
PACKAGE 3

SUPER BLUE VENT-A HOOD EXHAUST SYSTEM

PRESS	COLOR/SIZE	COATING/DRYING	PRICE
KOMORI LITHRONE	6 / 40	PBC/CII	$ 4,000.

PURPOSE

To be installed on the delivery of the press to exhaust moisture laden air, lowering the humidity within the delivery area. Reduces the need for spray powder increasing the efficiency of the existing dryer.

FEATURES

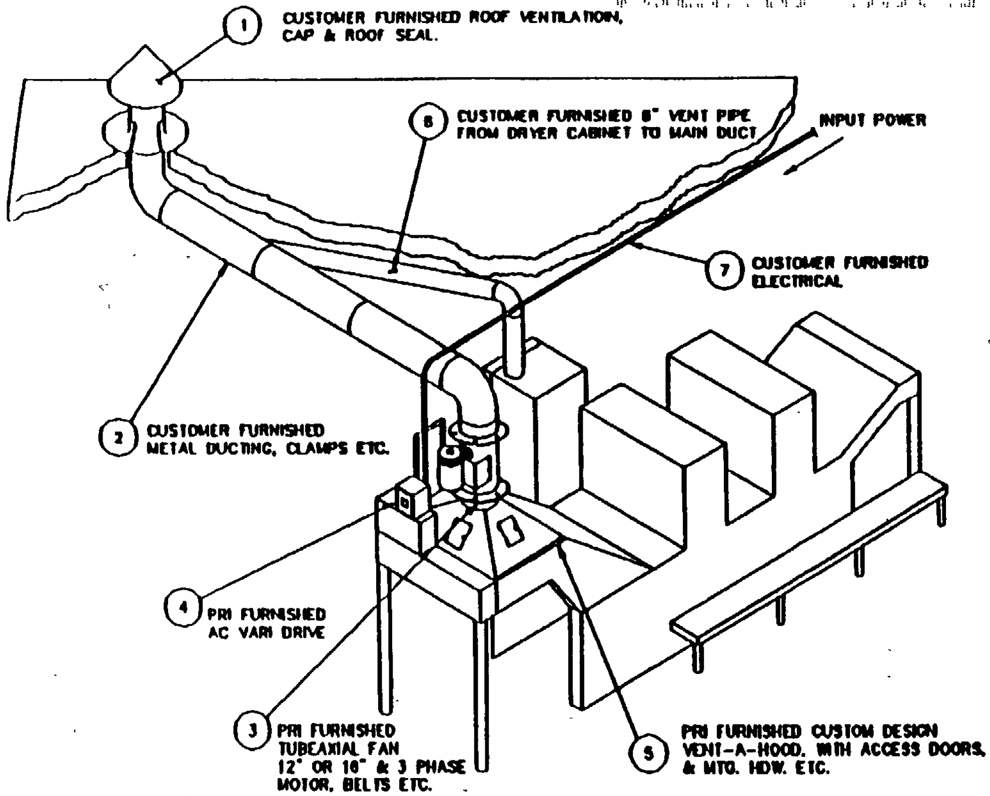
This specially designed exhaust system utilizes a high output fan with variable power speed control at the delivery of your press. The Vent-A-Hood exhaust helps minimize the build up of moisture within the drying area of the press.

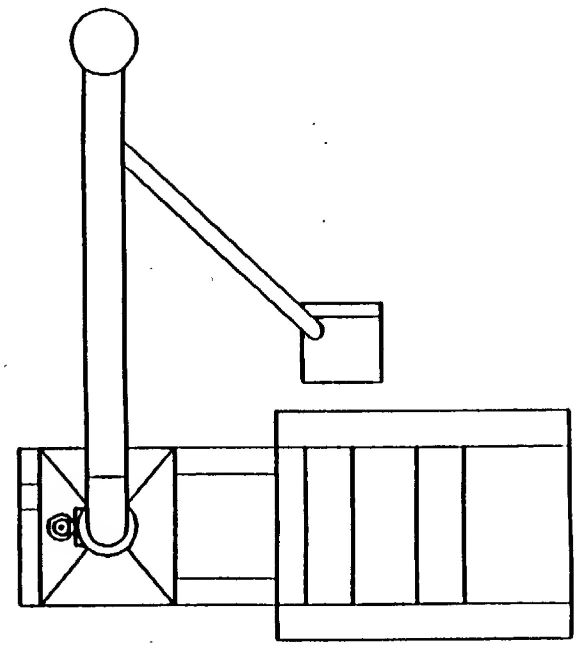
BENEFITS

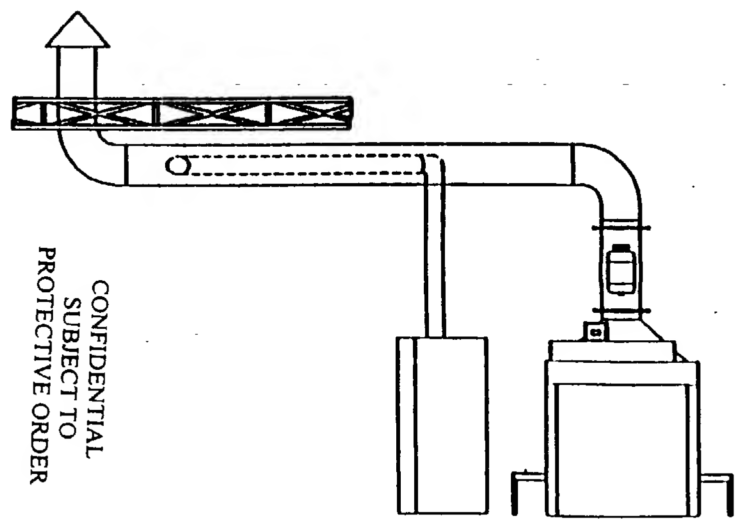
- Enhances the capabilities of your current dryer.
- Help remove excess spray powder.
- Minimizes unpleasant odors at the delivery.
- Reduces the need for spray powder.

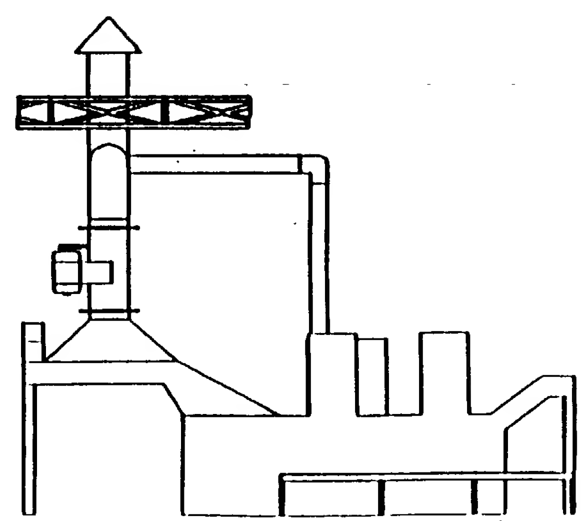
Enclosures: Sales Terms
Features Table

10954 Shady Trail Dallas, Texas 75220 U.S.A Telephone 214-353-9000 Telex 794028 Superblue dal Fax 214-357-5847


1 CUSTOMER FURNISHED ROOF VENTILATION, CAP & ROOF SEAL.
6 CUSTOMER FURNISHED 6" VENT PIPE FROM DRYER CABINET TO MAIN DUCT
INPUT POWER
7 CUSTOMER FURNISHED ELECTRICAL
2 CUSTOMER FURNISHED METAL DUCTING, CLAMPS ETC.
4 PRI FURNISHED AC VARI DRIVE
3 PRI FURNISHED TUBEAXIAL FAN 12" OR 16" & 3 PHASE MOTOR, BELTS ETC.
5 PRI FURNISHED CUSTOM DESIGN VENT-A-HOOD, WITH ACCESS DOORS, & MTG. HDW. ETC.







W001101

Printing Research, Inc.
"Mark-less" Super Blue®

HV 093988
Williamson Printing
June 25, 1993

PROPOSAL
PACKAGE 3

SUPER BLUE HV™ HIGH VELOCITY HOT AIR DRYING SYSTEM

PRESS	COLOR/SIZE	MAX KW OUTPUT	MAXIMUM CFM/ HEAT OUTPUT	PRICE
KOMORI LITHRONE	6 / 40	42 Per Cabinet	650/250°F Per Cabinet	$ 39,992. Per Cabinet

One HV cabinet feeding air knives and exhaust between printing units 1/2, 2/3, 5/6

PURPOSE

- Allow work and turn and post processing in minutes, not hours.
- Flashing off solvent and water in conventional inks between printing units.
- Minimize if not eliminate spray powder, when coating.
- Minimizing gloss back or dry back when coating.
- Enhancing drying of inks.
- Improving coating lay.
- Drying aqueous coatings between printing units prior to spot coating.
- Improving paper stability.

APPLICATION

Paper, Card, Carton Board, Corrugated

CONFIGURATION

- Air knives, exhaust and mounting brackets, with HV cabinet and pre-heater.
- HV cabinet contains switch gear and control components.
- Controls are interlocked with printing impression and emergency stop which turns dyers on and off.
- Dryer and electrical control cabinet are prewired to terminal boards to allow for faster installation.

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Enclosures: Sales Terms
Features Table

W001102

10954 Shady Trail Dallas, Texas 75220 U.S.A Telephone 214-353-9000 Telex 794028 Superblue dal Fax 214-357-5847

Super Blue HVL High Velocity Hot Air Drying System

FEATURES	ADVANTAGES	BENEFITS
○ High velocity hot air knives	○ Scrubs volatiles such as water and alcohol from paper surface and ink film prior to coating	○ Increases gloss levels of coatings by minimizing dry back
	○ Reduces drying time of ink under coating	○ Minimizes downtime by allowing faster commencement of work and turn and post press operations
	○ Minimizes if not eliminates spray powder when coating	○ Increased productivity due to less press maintenance
	○ Provides ability to print and coat full loads at optimum press speeds	○ Dramatically increases productivity and profitability
	○ Increases temperature of stock which reduces viscosity of coating on contact	○ Optimizes gloss levels ○ Allows for coating application with near perfect lay characteristics
	○ Dries water based coating at various positions on the press	○ Increases variety of saleable product
	○ Ink applied by previous unit is set	○ Improved dot definition ○ Better ink trapping ○ Helps prevent gas ghosting
○ Air knife exhaust system	○ Removes volatiles from press and production area	○ Decreases drying or setting time ○ Protects press functions and operators
○ Time delay on air knife and exhaust knife shut-off	○ Interstation areas are completely heat evacuated when press is stopped	○ Comfortable operator makeready and wash-up environment ○ Comprehensive press protection
○ Complete training of staff by PRI professionals (Including complete Operator's and Pre-Installation Manuals)	○ Knowledgeable operators at completion of installation and training	○ Increased productivity due to responsive training program by PRI ○ Ability to produce saleable sheets immediately after training

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W001103

Printing Research, Inc.
"Mark-less" Super Blue®

Williamson Printing
June 28, 1993

SUMMARY OF PROPOSAL
for
PACKAGE 4
OMCSA 2 / 40

	QTY	EQUIPMENT	UNIT PRICE	EXTENSION
A	2	SUPER BLUE PLATE BLANKET COATER (PBC)	$ 76,530.	$153,060.
B	1	SUPER BLUE BACVAC VACUUM DELIVERY SYSTEM (BV)	12,586.	12,586.
C	1	SUPER BLUE HIGH VELOCITY HOT AIR DRYING SYSTEM (HV)	39,992.	39,992.
D	1	SUPER BLUE THREE LAMP 'COLD' UV DRYING SYSTEM (CUV)	87,806.	87,806.
E	1	SUPER BLUE VENT-A-HOOD EXHAUST SYSTEM (VH)	4,000.	4,000.
		TOTAL EQUIPMENT (FOB Factory)		**$297,444.**

FREIGHT PREPAID AND ADDED TO INVOICE, INSTALLATION AND TRAINING CHARGED AT $575. PER DAY PER MAN PLUS AIRFARES

	QTY	RECOMMENDED SPARE PARTS	UNIT PRICE	EXTENSION
A	1	SPARE APPLICATOR ROLL (per inch)	70.	$ 2,800.
	1	SPARE METERING ROLL (per inch)	45.	1,800.
B/C/E		NONE REQUIRED		-------
D	3	SPARE U.V. LAMPS	338.	1,014.
	2	FILTER TUBES	587.	1,174.
	3	DEIONIZING RESIN CARTRIDGES	50.	150.
		TOTAL RECOMMENDED SPARE PARTS		**$ 6,938.**

PROPOSAL, TERMS AND CONDITIONS OF SALE ON REVERSE SIDE ACCEPTED BY:

NAME ______________________

TITLE ______________________

SIGNATURE ______________________

DATE ______________________

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PROTECTIVE ORDER

W001104

10954 Shady Trail Dallas, Texas 75220 U.S.A. Telephone 214-353-9000 Telex 794028 Superblue dal Fax 214-357-5847

Printing Research, Inc.
"Mark-less" Super Blue®

PBC 093988
Williamson Printing
June 25, 1993

PROPOSAL
PACKAGE 4

SUPER BLUE PBC PLATE AND BLANKET COATER

PRESS	COLOR/SIZE	PRICE
OMCSA	2 / 40	$ 76,530. (each)

One on printing unit one and one on printing unit two

RECOMMENDED SPARE PARTS:

Spare Rolls:	Applicator (per inch)	$ 70.
	Metering (per inch)	$ 45.
Spare Pump Stand:	If intention is to run both aqueous and UV	$ 4,000.

PURPOSE

Application of aqueous or UV coatings to either the plate or blanket cylinder of a press unit, for spot or area coating with exceptional uniformity, clean edges and precise registration.

APPLICATION

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PROTECTIVE ORDER

Paper, Card, Carton Board, Corrugated, Plastic, Foil

CONFIGURATION

W001105

Speed control is maintained via throttling valves mounted on the control cabinet. Start/stop controls are interlocked with press controls to suit. All rolls are variable speed and are ramped to match the selected percentage of surface speed. Applicator roll normally drives slower than plate or blanket surface speed, while metering roll and pick up or pan roll are always less than the applicator. The applicator roll automatically follows the direction of the plate or blanket.

The metering and applicator rollers are rubber, while the pick up roll is chromed microfinished. The metering roll has left and right hand adjustments for on-off contact with pick-up roll and independent manual screw adjustments to set profile. Each roll has vernier indicators for gap adjustment. A stainless steel coater pan is designed for recirculation of coating via a diaphragm pump with a large diameter hose used to return the coating to a 55 gallon drum. The diaphragm pump is plumbed and is installed on a stainless steel coating drum cover incorporating a hinged plexiglass viewing window and an adjustable, audible, and visual warning system.

Super Blue PBC Plate Blanket Coater

FEATURES	ADVANTAGES	BENEFITS
○ Fully retractable Spot Plate or Blanket coating	○ Ability to spot or overall coat ○ In-line coating flexibility without dedicating the last printing unit to coating	○ Maximum utilization of printing units
○ Application of coating from plate cylinder	○ Elimination of lengthy downtime due to registering coating to image ○ Negates need to cut blankets while press down ○ Sharp clean, crisp image definition ○ Water-based coating can replace and surpass press varnish ○ Coatings have higher scuff resistance than press varnish and are non-yellowing	○ Simple precise register control ○ Increased productivity and profitability ○ Insurmountable quality ○ Value added to printed sheets ○ Increased product durability and cosmetic quality
○ Application of coating from blanket cylinder	○ Fast makeready since overall coating directly applied from blanket cylinder ○ Heavy overall coating film weights easily applied ○ Functional coatings such as remoistenable gum and blister pack coatings easily applied	○ Increased productivity and profitability ○ Optimizing gloss and physical properties ○ Added value to printed work and increased product range capabilities
○ Sheer application of coatings	○ Uniform thickness of coating from the plate cylinder ○ Minimizes slinging or misting of coatings ○ Allows the widest range of viscosities to be used ○ Water based coatings will stay open indefinitely on coater while circulating	○ The best coating lay characteristics for optimized added value ○ Prevents costly cleanups ○ Optimizes gloss and physical properties ○ Minimizes downtime through wash-ups, operators can concentrate on press operation creating higher productivity
○ Coating pump stand with run dry protection	○ Visual and audible warning of low coating level in barrel	○ Complete operator awareness alert and non-stop production
○ Complete training of staff by PRI professionals (Including complete Operator's and Pre-Installation Manuals)	○ Knowledgeable operators at completion of installation and training ○ Recommendation of all production consumables available for start-up.	○ Increased productivity due to responsive training program by PRI ○ Ability to produce saleable sheets immediately after training

Printing Research, Inc.
"Mark-less" Super Blue®

BV 093988
Williamson Printing
June 25, 1993

PROPOSAL
PACKAGE 4

SUPER BLUE BACVAC DELIVERY VACUUM TRANSFER SYSTEM

PRESS	COLOR/SIZE	PRICE
OMCSA	2 / 40	$ 12,586.

PURPOSE

- Optimized press speeds with minimal risk of marking varnish, water based or U.V. coatings.
- Stop unnecessary delivery wheel makeready.
- Eliminate starwheel and stop press adjustments.

APPLICATION

Paper, Card, Carton Board, Plastic, Foil

CONFIGURATION

A vacuum transfer system which eliminates marking completely for sheet fed presses. The press grippers pull the sheet, dry side against the BACVAC rollers, which are contoured to the original cylinder path. The vacuum holds the sheets against the rollers, ensuring that the printed and or coated side of the sheet does not come into contact with any surface whatsoever.

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Enclosures: Sales Terms
Features Table

W001107

10954 Shady Trail Dallas, Texas 75220 U S A Telephone 214-353-9000 Telex 794028 Superblue dal Fax 214-357-5847

Super Blue BacVac

FEATURES	ADVANTAGES	BENEFITS
Vacuum Transfer System with frictionless free wheeling roller support	Assures markfree printed or coated sheets at delivery transfer	Optimized press speed assures higher productivity and profitability.
	Provides ability to print or coat any thickness or grain direction of stock.	Creates total flexibility in choice of stock
	Any stock adheres to vacuum transfer at full press speeds	Guaranteed quality of heavy ink coverage, varnished or coated work.
		Reduced spoilage and over runs
	Decreases need to purchase special stock	Provides added value to finished sheets
	Non-printed or non-coated side of sheet is held by vacuum to the contour of the BacVac rollers	Maximizes ink, varnish or coating applications without marking
	Printed or coated side of sheet does not make contact with any surface	Full coverage without scratching or marking.
	Fully automatic, maintenance free, no adjustments	Eliminates make ready down time at delivery transfer increasing productivity and profitability
	No special tools, no stop press adjustments, no delivery adjustments necessary	
Energy efficient vacuum motor	Continuous controlled air flow	Low cost energy consumption
Automatic on/off	No adjustments necessary	
Complete training of staff by PRI professionals	Knowledgeable operators at completion of installation and training	Increased productivity due to responsive training program by PRI
(Including complete Operator's and Pre-Installation Manuals)		Ability to produce saleable sheets immediately after training.

Printing Research, Inc.
"Mark-less" Super Blue®

HV 093988
Williamson Printing
June 25, 1993

PROPOSAL
PACKAGE 4

SUPER BLUE HV™ HIGH VELOCITY HOT AIR DRYING SYSTEM

PRESS	COLOR/SIZE	MAX KW OUTPUT	MAXIMUM CFM/ HEAT OUTPUT	PRICE
OMCSA	2 / 40	42 Per Cabinet	650/250°F Per Cabinet	$ 39,992. Per Cabinet

One HV cabinet feeding air knives and exhaust between printing units 1/2, delivery

PURPOSE

- Allow work and turn and post processing in minutes, not hours.
- Flashing off solvent and water in conventional inks between printing units.
- Minimize if not eliminate spray powder, when coating.
- Minimizing gloss back or dry back when coating.
- Enhancing drying of inks.
- Improving coating lay.
- Drying aqueous coatings between printing units prior to spot coating.
- Improving paper stability.

APPLICATION

Paper, Card, Carton Board, Corrugated

CONFIGURATION

- Air knives, exhaust and mounting brackets, with HV cabinet and pre-heater.
- HV cabinet contains switch gear and control components.
- Controls are interlocked with printing impression and emergency stop which turns dyers on and off.
- Dryer and electrical control cabinet are prewired to terminal boards to allow for faster installation.

Enclosures: Sales Terms
Features Table

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PROTECTIVE ORDER

W001109

10954 Shady Trail Dallas, Texas 75220 U.S.A Telephone 214-353-9000 Telex 794028 Superblue dal Fax 214-357-5847

Super Blue HVL High Velocity Hot Air Drying System

FEATURES	ADVANTAGES	BENEFITS
○ High velocity hot air knives	○ Scrubs volatiles such as water and alcohol from paper surface and ink film prior to coating	○ Increases gloss levels of coatings by minimizing dry back
	○ Reduces drying time of ink under coating	○ Minimizes downtime by allowing faster commencement of work and turn and post press operations
	○ Minimizes if not eliminates spray powder when coating	○ Increased productivity due to less press maintenance
	○ Provides ability to print and coat full loads at optimum press speeds	○ Dramatically increases productivity and profitability
	○ Increases temperature of stock which reduces viscosity of coating on contact	○ Optimizes gloss levels ○ Allows for coating application with near perfect lay characteristics
	○ Dries water based coating at various positions on the press	○ Increases variety of saleable product
	○ Ink applied by previous unit is set	○ Improved dot definition ○ Better ink trapping ○ Helps prevent gas ghosting
○ Air knife exhaust system	○ Removes volatiles from press and production area	○ Decreases drying or setting time ○ Protects press functions and operators
○ Time delay on air knife and exhaust knife shut-off	○ Interstation areas are completely heat evacuated when press is stopped	○ Comfortable operator makeready and wash-up environment ○ Comprehensive press protection
○ Complete training of staff by PRI professionals (Including complete Operator's and Pre-Installation Manuals)	○ Knowledgeable operators at completion of installation and training	○ Increased productivity due to responsive training program by PRI ○ Ability to produce saleable sheets immediately after training

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W001110

Printing Research, Inc.
"Mark-less" Super Blue®

CUV 093988
Williamson Printing
June 25, 1993

PROPOSAL
PACKAGE 4

SUPER BLUE 'COLD' UV DRYING SYSTEM

PRESS	COLOR/SIZE	LAMPS	RATING	PRICE
OMSCA	2 / 40	3	300 watt/inch	$ 87,806.

RECOMMENDED SPARE PARTS:

UV Lamps (each)	$338.
Filter Tubes (each)	$587.
Deionizing Resin Cartridge (each)	$ 50.

PURPOSE

Curing (drying) UV inks, varnishes or coating on sheet or web fed presses.

APPLICATION

Paper, Card, Carton Board, Corrugated, Plastic, Foil

CONFIGURATION

Curing heads are linked to impression of press and automatically switch to standby mode when press is off impression for five minutes. If no further action is taken, then lamps automatically turn off; if the press is put back into impression, the lamps automatically return to full power.

Standard Control Unit contains all necessary switchgear and controls to provide individual lamp selection, full and reduced individual power switching, elapsed life meters, lamp indicators and emergency stop button.

Main power transformer, capacitor banks and closed loop exchanger plant are supplied as floor standing modules. Full safety interlock circuits are fitted throughout. Ozone and heat extraction from the press are not normally required.

Enclosures: Sales Terms
Features Table

10954 Shady Trail Dallas, Texas 75220 U.S.A Telephone 214-353-9000 Telex 794028 Superblue dal Fax 214-357-5847

SUPER BLUE 'COLD' UV DRYING SYSTEM

FEATURES	ADVANTAGES	BENEFITS
Quartz Filter Tubes carrying deionized distilled water	Allows 98-99% of the UV to pass through	Maximizes curing efficiency which results in full production press speeds
	Filters most of the unwanted heat	Minimizes risk of fire and resultant downtime
	Ensures low stack temperatures	Eliminates risk of distortion of heat sensitive stock
Closed Loop Deionizing chilled water system	Allows complete temperature control of water recirculation system	No costly losses of heating or cooling energy from the plant
Low Volume Compressed Air Lamp Cooling	Ensures minimal ozone production	Creates a safe work place environment meeting all OSHA and EPA standards
	Ensures lamp running temperatures are precise	Assures optimum efficiency level of UV output
Heat Exhaust System (HES) installed between printing units	Reduces heat build-up created by chemical reaction of inks	Eliminates expensive downtime caused by ink piling on the blankets
	Reduces tack levels of ink	Decreases risk of hickies and the cost of downtime to remove hickies on work and turn
	Prevents heat build-up between printing units	Protects press functions and operators
Water cooled UV lamp head and delivery reflector pan	Absorbs most of the unwanted heat	Prevents risk of press damage
	Prevents heat build-up of delivery stack	Eliminates risk of stock distortion in stack
		Decreases risk of waste sheets caused by offsetting of C2S stock when printed or coated first side
Complete Training of staff by PRI professionals (Including complete Operator's and Pre-Installation Manuals)	Knowledgeable operators at completion of installation and training	Increased productivity due to responsive training program by PRI
		Ability to produce saleable sheets immediately after training

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W001112

Printing Research, Inc.
"Mark-less" Super Blue®

VH 093988
Williamson Printing
June 25, 1993

PROPOSAL
PACKAGE 4

SUPER BLUE VENT-A HOOD EXHAUST SYSTEM

PRESS	COLOR/SIZE	COATING/DRYING	PRICE
OMCSA	2 / 40	PBC/HV-CUV	$ 4,000.

PURPOSE

To be installed on the delivery of the press to exhaust moisture laden air, lowering the humidity within the delivery area. Reduces the need for spray powder increasing the efficiency of the existing dryer.

FEATURES

This specially designed exhaust system utilizes a high output fan with variable power speed control at the delivery of your press. The Vent-A-Hood exhaust helps minimize the build up of moisture within the drying area of the press.

BENEFITS

- Enhances the capabilities of your current dryer.
- Help remove excess spray powder.
- Minimizes unpleasant odors at the delivery.
- Reduces the need for spray powder.

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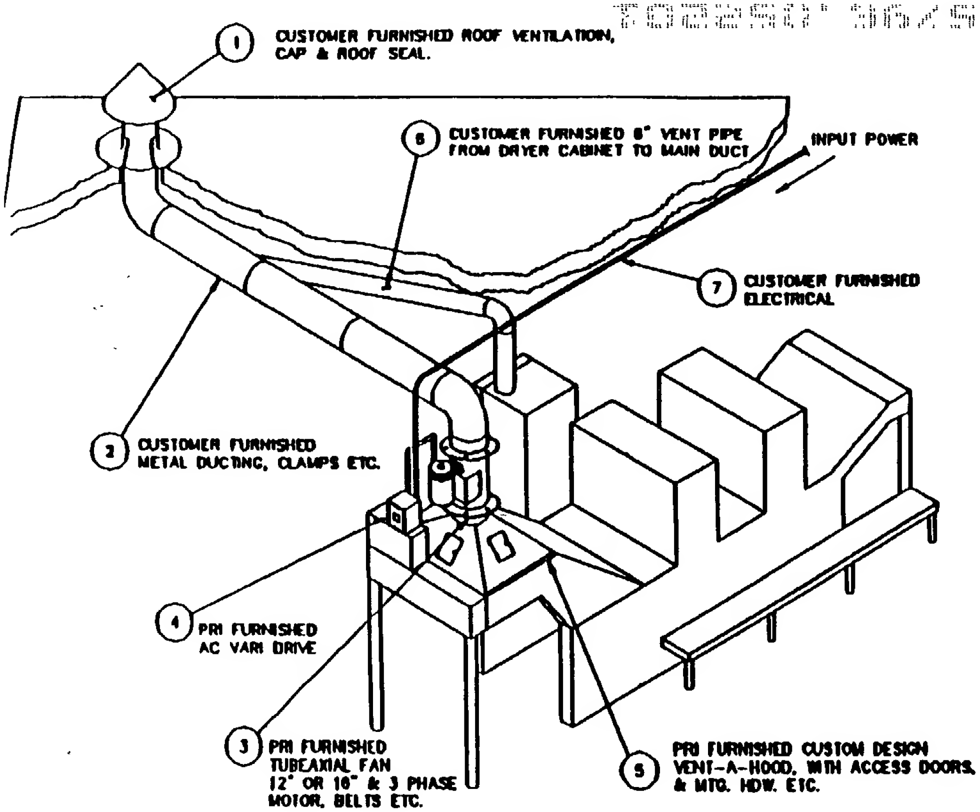
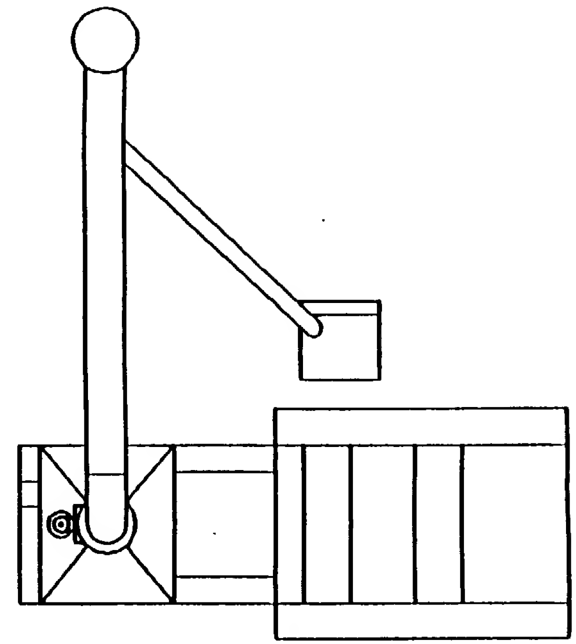
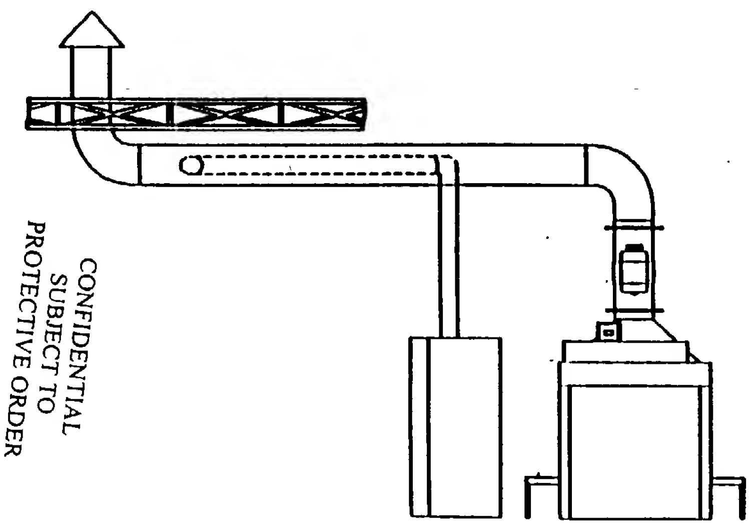
W001113

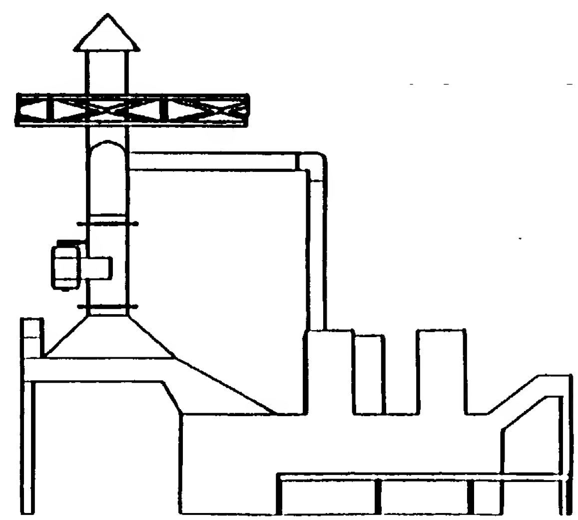
Enclosures: Sales Terms
Features Table

10954 Shady Trail Dallas, Texas 75220 U.S.A. Telephone 214-353-9000 Telex 794028 Superblue dal Fax 214-357-5847


1 CUSTOMER FURNISHED ROOF VENTILATION, CAP & ROOF SEAL.
6 CUSTOMER FURNISHED 8" VENT PIPE FROM DRYER CABINET TO MAIN DUCT
INPUT POWER
7 CUSTOMER FURNISHED ELECTRICAL
2 CUSTOMER FURNISHED METAL DUCTING, CLAMPS ETC.
4 PRI FURNISHED AC VARI DRIVE
3 PRI FURNISHED TUBEAXIAL FAN 12" OR 16" & 3 PHASE MOTOR, BELTS ETC.
5 PRI FURNISHED CUSTOM DESIGN VENT-A-HOOD, WITH ACCESS DOORS, & MTG. HDW. ETC.







Printing Research, Inc.
"Mark-less" Super Blue®

Williamson Printing
June 25, 1993

SUMMARY OF PROPOSAL
PACKAGE 5

KOMORI LITHRONE 6 / 40

QTY	EQUIPMENT	UNIT PRICE	EXTENSION
2	SUPER BLUE HIGH VELOCITY HOT AIR DRYER SYSTEM (HV)	$ 39,992.	$ 79,984.
	TOTAL EQUIPMENT (FOB Factory)		$ 79,984.

FREIGHT PREPAID AND ADDED TO INVOICE, INSTALLATION AND TRAINING CHARGED AT $575. PER DAY PER MAN PLUS AIRFARES

QTY	RECOMMENDED SPARE PARTS	UNIT PRICE	EXTENSION
	NONE REQUIRED		

PROPOSAL, TERMS AND CONDITIONS OF SALE ON REVERSE SIDE ACCEPTED BY:

NAME ____________________

TITLE ____________________

SIGNATURE ____________________

DATE ____________________

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W001115

Printing Research, Inc.
"Mark-less" Super Blue®

HV 093988
Williamson Printing
June 25, 1993

PROPOSAL
PACKAGE 5

SUPER BLUE HV™ HIGH VELOCITY HOT AIR DRYING SYSTEM

PRESS	COLOR/SIZE	MAX KW OUTPUT	MAXIMUM CFM/ HEAT OUTPUT	PRICE
KOMORI LITHRONE	6 / 40	42 Per Cabinet	650/250°F Per Cabinet	$ 39,992. Per Cabinet

One HV cabinet feeding air knives and exhaust between printing units 1/2, 2/3, 3/4
One HV cabinet feeding air knives and exhaust between printing units 4/5, 5/6

PURPOSE

- Allow work and turn and post processing in minutes, not hours.
- Flashing off solvent and water in conventional inks between printing units.
- Minimize if not eliminate spray powder, when coating.
- Minimizing gloss back or dry back when coating.
- Enhancing drying of inks.
- Improving coating lay.
- Drying aqueous coatings between printing units prior to spot coating.
- Improving paper stability.

APPLICATION

Paper, Card, Carton Board, Corrugated

CONFIGURATION

- Air knives, exhaust and mounting brackets, with HV cabinet and pre-heater.
- HV cabinet contains switch gear and control components.
- Controls are interlocked with printing impression and emergency stop which turns dyers on and off.
- Dryer and electrical control cabinet are prewired to terminal boards to allow for faster installation.

Enclosures: Sales Terms
Features Table

Super Blue HVL High Velocity Hot Air Drying System

FEATURES	ADVANTAGES	BENEFITS
High velocity hot air knives	Scrubs volatiles such as water and alcohol from paper surface and ink film prior to coating	Increases gloss levels of coatings by minimizing dry back
	Reduces drying time of ink under coating	Minimizes downtime by allowing faster commencement of work and turn and post press operations
	Minimizes if not eliminates spray powder when coating	Increased productivity due to less press maintenance
	Provides ability to print and coat full loads at optimum press speeds	Dramatically increases productivity and profitability
	Increases temperature of stock which reduces viscosity of coating on contact	Optimizes gloss levels Allows for coating application with near perfect lay characteristics
	Dries water based coating at various positions on the press	Increases variety of saleable product
	Ink applied by previous unit is set	Improved dot definition Better ink trapping Helps prevent gas ghosting
Air knife exhaust system	Removes volatiles from press and production area	Decreases drying or setting time Protects press functions and operators
Time delay on air knife and exhaust knife shut-off	Interstation areas are completely heat evacuated when press is stopped	Comfortable operator makeready and wash-up environment Comprehensive press protection
Complete training of staff by PRI professionals (Including complete Operator's and Pre-Installation Manuals)	Knowledgeable operators at completion of installation and training	Increased productivity due to responsive training program by PRI Ability to produce saleable sheets immediately after training

PRINTING RESEARCH, INC.
TERMS OF PROPOSAL

1. PRICING: Prices are based on clear access to and within the press to install our standard equipment. Any variance, deviation or encumbrance will be subject to price review. Installation is priced separately and all electrical, plumbing, engineering or other contracted services including materials to prepare the site for installation are the customers responsibility.
2. TERMS: 40% with purchase order and signed sales contract. 50% upon notification of readiness for shipment. Please note in order to release shipments, payment must be received. Balance 30 days after installation or 45 days from delivery, whichever is earlier. Please Note, when payment for a unit is due, it is payable without regard to the status of another unit which might be purchased at the same time.
3. WARRANTY CONDITIONS: 12 months on defective parts. EXCEPTION: UV Lamps - All guaranteed for 1000 operating hours. If failure occurs prior to 1000 hours of operation, 100% credit or a free replacement lamp will be provided.
4. CONDITIONS OF SALE: This quotation is subject to our "General Terms and Conditions Coating and Drying Systems" on reverse of Summary. The company accepts no liability whatsoever for any loss of production, loss of profit or other loss to customer in connection with the equipment and/or its installation.
5. STANDARD DELIVERY: Is usually 12 - 16 weeks from receipt of official order and first stage payment. FOB Factory.
6. INSTALLATION AND TRAINING: $575.00 per day per man plus airfare.
7. ELECTRICAL STANDARD: 220/460/480 volts, 3 or 4 wire (Delta or Wye) 60 hz.
   Note: Electrical services must be specified on the purchase order.
8. SERVICES TO BE PAID FOR AND PROVIDED BY CUSTOMER:

   GENERAL: Buyer agrees to prepare the press for installation, which may require relocating accessories including spray powder units, static bars, etc. Any relocation or modification of accessorieswill be the sole responsibility of the buyer. In the event Printing Research (P.R.I.) technicians are requested to modify or relocate any accessory, there will be an additional charge assessed to the buyer based on P.R.I.'s applicable hourly rate. P.R.I. will not warranty the performance of any accessories moved. When applicable, the buyer will supply clean, dry compressed air.

   HV/PBC/IR/UV/EZ/BV/VH
   The customer agrees to supply and pay for electricians, plumbers, engineering services and all materials required to install and interconnect (if necessary) the equipment being supplied by Printing Research, Inc. The electrical, plumbing, water, compressed air and refrigeration lines being supplied by the customer are to be connected to the equipment being installed. Printing Research, Inc. is responsible for activating the installed systems and will supply the labor necessary in that regard.
9. ADDITIONAL SPECIFIC SERVICES TO BE PROVIDED BY CUSTOMER:

   HV (High Velocity Hot Air Dryer)
   - ☐ Provide duct work and duct work extraction.
   - ☐ Provide raised walkplates to cover air supply and return lines lying on the floor.

   PBC (Plate Blanket Coater)
   - ☐ Provide coating and cleaning agent for testing and training.
   - ☐ 55 gallon barrel of hydraulic oil
   - ☐ Compressed air line up to 100 p.s.i.
   - ☐ Lifting gear to place coater on press
   - ☐ Provide relief plate to conduct plate coating test.

   UV (Water Cooled and 'Cold' UV)
   - ☐ Duct work and extraction, if required
   - ☐ Clean, dry compressed air adjacent to within 10 feet of the location of lamps; compressor must be able to deliver 0.5 c.f.m. per linear inch per lamp at up to 100 p.s.i.
   - ☐ The chilling system is not precharged with refrigerant due to the variability of installation requirements and is priced accordingly. The customer agrees to pay for all refrigerant needed to complete the installation.

   'COLD' UV
   - ☐ Provide 25-50 gallons of non-charcoal filtered steam distilled water.

   EZ (EZ Impression Cylinder Coater)
   - ☐ Compressed air line up to 100 p.s.i.
   - ☐ Provide coating and cleaning agent for testing and training.

   VH (Vent-A-Hood)
   - ☐ Provide all duct work including penetrating and resealing the ceiling and/or roof and electrical interconnections to other equipment.
10. LOCAL INSPECTIONS, PERMITS OR CERTIFICATIONS:
    - ☐ Any additional local inspections, permits or certifications and the costs thereof are the sole responsibility of the buyer.

Prices are firm 60 days from the date of this proposal.

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US005370976A

United States Patent [19]

Williamson et al.

[11] Patent Number: 5,370,976

[45] Date of Patent: Dec. 6, 1994

[54] METALLIC COLOR PRINTING PROCESS

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[73] Assignee: **Williamson Printing Corporation**, Dallas, Tex.

[21] Appl. No.: **887,510**

[22] Filed: **May 22, 1992**

[51] Int. Cl.^{5} **G03C 7/00**; G03C 5/00; G03F 9/00; H04N 1/21

[52] U.S. Cl. **430/358**; 430/359; 430/22; 430/30; 358/798, 358/534; 358/536

[58] Field of Search .... 430/358, 359, 30, 293, 430/301, 21, 143, 43, 44, 347, 106/19 R, 358/75, 80, 534, 536, 298

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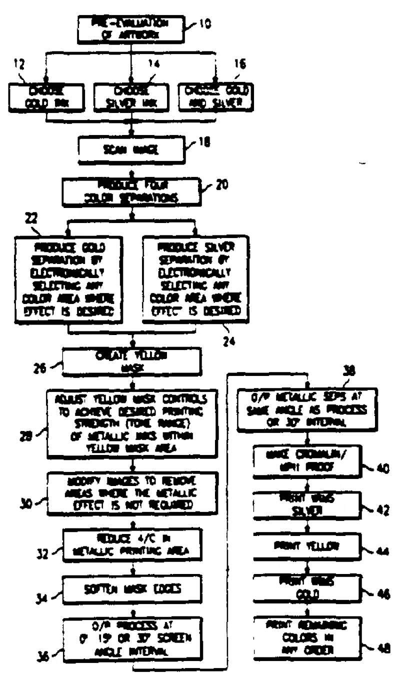
Assistant Examiner—J. Pasterczyk
Attorney, Agent, or Firm—Jones, Day, Reavis & Pogue

[57] **ABSTRACT**

A method of reproducing on a substrate an image incorporating metallic inks involves scanning (18) the image to be reproduced and creating (20) four color separations of the scanned image. Metallic gold and/or metallic silver color separations (22, 24) are created by electronically selecting any color area where the effect is desired. Next, the color separations are edited by creating (26) an electronic yellow mask of the image and adjusting (28) the desired tonal range of the metallic areas. The mask edges of each color separation can also be softened (34). The scanner then outputs (36, 38) the separations to film. The image is then reproduced by printing each of the process color separation films (44, 48) and the metallic separation films (42, 46) onto a substrate.

12 Claims, 2 Drawing Sheets



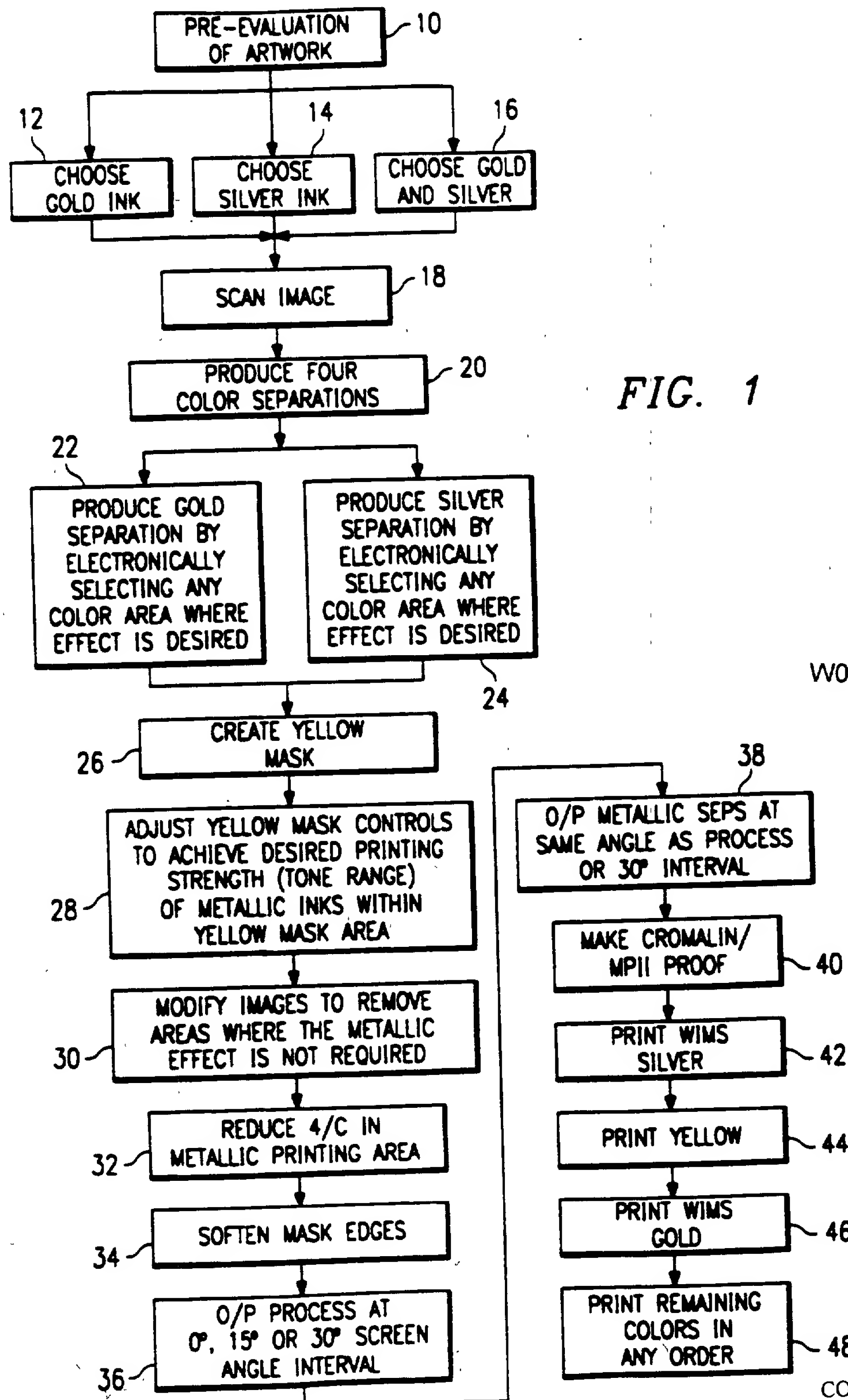


FIG. 1

W001120

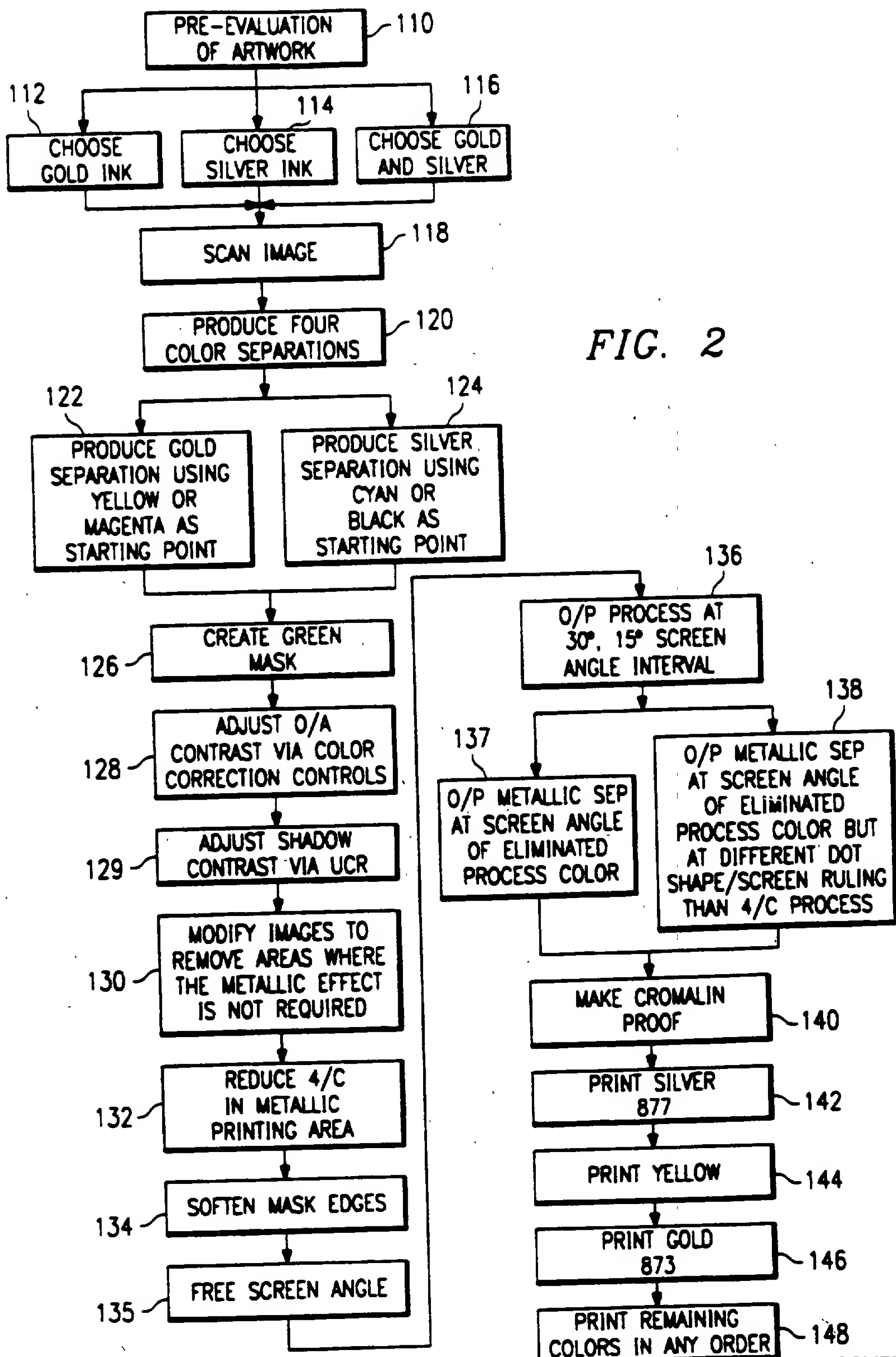


FIG. 2

W001121

METALLIC COLOR PRINTING PROCESS

TECHNICAL FIELD OF THE INVENTION

The present invention relates to a metallic color printing process. Specifically, this method produces an improved metallic image by printing the subtractive primary colors, black, metallic gold and/or metallic silver at four screen angles.

BACKGROUND OF THE INVENTION

The reproduction of color was first achieved by Scottish physicist James Maxwell in the mid 1850's. Maxwell photographed a scene three times, once through a red filter, once through a green filter, and once through a blue filter. These black-and-white negatives were contacted to produce positives that were then mounted as slides. Each slide was placed in a different projector and the images were focused together on a screen. A red, green, or blue filter was placed over the lens of each respective projector, thus producing a color image on the screen.

The first single film image for color photography was produced by Louis Ducos du Huron in France in the late 1860's. In his system, the image on a black-and-white panchromatic emulsion was broken up by a series of red, green, and blue transparent dots or lines that formed a screen in front of the emulsion. The dots and lines were so small that they could not be resolved by the eye. After exposure, the film was reversal-processed to yield a colored positive transparency. The additive-color transparency is still used by the Polaroid Corporation with their 35-ram Polachrome slide process.

The development of the subtractive color systems was also pioneered by du Huron. He suggested making separation negatives through red, green, and blue filters, then making positive transparencies from each, dyeing them with colors that absorb each respective primary color (i.e. cyan, magenta, and yellow). This subtractive method is difficult to use because it requires the accurate registration of the colored positives or the accurate registration of images from dyed positive matrices. The solution was a three-emulsion film, each layer made sensitive to a different color (red, green, or blue) and then dyed a different color (cyan, magenta, or yellow) in processing. The first successful film of this type was Kodachrome, introduced by the Eastman Kodak Company in 1935.

Printed color reproduction is based on many of the same principles as film color reproduction. Instead of a continuous image, allowed by the film medium, a series of dots are printed on a substrate. These dots are printed in the subtractive primary colors of cyan, magenta, and yellow. Additionally, black is used to adjust the contrast of the image. In the subtractive process, a white substrate is used and red, green, and blue are essentially subtracted to achieve black. By contrast, in the additive system, a black background (i.e. a blank TV screen) is used, and red, green, and blue are added to achieve white. In the additive system the following combinations create the following results:

Red + Green = Yellow
Red + Blue = Magenta
Green + Blue = Cyan
Red + Green + Blue = White

In the subtractive process, the following is true:

White + Yellow + Cyan = Green
White + Magenta + Cyan = Blue
White + Magenta + Yellow = Red
White + Yellow + Magenta + Cyan = Black

Moreover, each subtractive primary color when added with white produces that same subtractive primary color.

The objective in printing is to produce yellow, magenta, and cyan printing plates that are negative records of the amounts of blue, green, and red in the original. This is achieved by first photographing the original, in turn, through blue, green, and red filters. These films may then be converted into a halftone dot image suitable for a given printing process. The films are then used to make the image carriers, which may be plates, cylinders, or stencils. Each plate is inked with its appropriate ink, which is then transferred to a white substrate.

The image produced is largely dependant upon dot size and orientation. Orientation is defined primarily by the screen angle of the dot. The screen angle is the angle at which the rulings of a halftone screen are set when making screened images. In other words, the screen angle of a dot is the angle of the line which bisects the often elliptical dots. Standard screen angles have been established for various colors of dots: Magenta (45°), Cyan (75°), Yellow (90°), Black (105°). The interaction of screen angle, color, and dot size effect the quality of the reproduction.

Printing metallic colors, such as metallic gold and metallic silver, poses additional problems. Gold has typically been treated as a shade of yellow, while silver has been treated as a shade of gray. Thus the brilliance of these colors is diminished by the blending of hues which occurs in a four color printing system.

A system known as Metallic Integrated Printing Process (MIPP) has been developed for the reproduction of metallic colors by Eckart-Werke Metal Pigments and Powders of Furth, Bayern, Germany. This system requires numerous steps. First, a designer marks-up the artwork to be copied to designate those areas where the MIPP system is required, i.e. metallic colored areas. Next, a conventional four color separation is produced of the artwork. Each separation is then compared to the original artwork to see which separation gives the best representation of the metallic colors. Based on the object color in the original photograph and the color requirements of the final print, a determination is then made whether gold or silver is required. Most shades of gold can be obtained from silver and yellow. However, a high percentage of yellow on silver greatly reduces the metallic brilliance. In addition, silver has a grey value of approximately 30% that tends also to reduce the metallic brilliance and thereby dirty colors.

After the four color separations are made, two separations used to print the metallic inks must be developed from two of the four separations. Typically the cyan or black separation will give the best basis for developing the silver separation and either the yellow or magenta for the gold separation. The selected separations are then duplicated to become the gold and silver separations. These separations may require modification to remove image areas where a metallic effect is not required. Comparison with the original transparency may indicate the need to enhance some image areas so as to improve the final metallic effect. The MIPP system anticipates the softening of mask edges of the metallic colors to avoid sharp cut-out effects when the final result is printed. In practice, the task of softening of

mask edges can be handled using electronic image processing equipment.

With the MIPP systemic, a screen angle must be freed for each of the metallic inks to avoid problems of screen clash and resulting moire effects. This can be accomplished by using achromatic or Under Color Removal, ("UCR") color separation techniques where the process color with the lowest value is eliminated in favor of black. UCR involves the technique of reducing the cyan, magenta, and yellow content in neutral grey shadow areas of a reproduction and replacing them with black ink so that the reproduction will appear normal but will use less process color ink. (From the Complete Color Glossary by Miles Southworth, Thad McIlroy and Donna Southworth, Copyright 1992, Published by The Color Resource, Livonia, N.Y. ISBN 1-879847-01-9). Often the cyan will have the lowest value and is the color to eliminate. Since both gold and silver have a process color value, the four conventional separations will need to be modified if the finished print is not to look over-colored or dirty. For example PANTONE 873, the MIPP gold standard, has a process color value of approximately 65% yellow, 25% magenta and 5% cyan. So if the gold areas are to look realistic these colors must be reduced proportionately The separations may also require modification as the metallic inks have a grey scale value and a failure to take this into account may result in a dirtying of the final colors due to a reduction in their metallic brilliance.

A MIPP image is printed using standard screen angle intervals of 30° or 15°. The screen angle used for a metallic ink is the same as that for the process colors eliminated in favor of a metallic ink. The MIPP system may use different dot shapes to reduce the risk of screen clash. A round dot, with no preferred direction, is typically used for the metallic ink, while an elliptical dot works for the standard process inks. The color standards chosen for MIPP come from the PANTONE System of matched metallic inks, with PANTONE 873 as the gold standard and PANTONE 877 as the silver standard.

Because metallic inks are opaque, they are normally printed before the transparent process colors. But with MIPP the sequence is changed slightly so that the first three colors down are silver, yellow, and gold, respectively. The remaining three process colors are printed in any order. The first three colors, in this order, are very important if the finished print is to look realistic. The use of yellow on silver is necessary to obtain yellow, green and orange metallic effects. Yellow, under gold, is also necessary to maintain the correct tonal values in the highlight areas. Yellow, printed in this way, provides a transition from gold to non-metallic parts of the image. On the other hand, if yellow is printed on top of the gold, there is a loss of metallic sheen without any compensating color benefit.

In summary, the MIPP system presents several disadvantages. First, it requires excessive handwork to create the color mash. Second, the MIPP system requires the elimination of one of the subtractive process colors to free up a screen angle for a metallic color. Third, the MIPP system only allows the printing of four screened colors in any given area. Last, the PMS 873 standard gold ink used by the MIPP system is a dirty, or less brilliant gold ink. This dirty look limits the gold color reproduction to the inherent dirty look even if no other color ink is printed in that area. This dirty look also necessitates additional color correction of the sub tractive primaries. Therefore, a need exists for a printing process which maximizes the appearance of metallic colors. Such a process should allow the use of six colors printed at four screen angles Moreover, such a process should not limit the number of colors in any given area to four as with the MIPP System.

SUMMARY OF THE INVENTION

The present invention relates to the Williamson Integrated Metallic System (WIMS) developed to allow six color printing using yellow, magenta, cyan, black, metallic silver, and/or metallic gold. The WIMS System creates a realistic metallic gold or metallic silver effect using the subtractive primary colors, black, silver and/or gold. The WIMS method comprises a number of steps. The subject to be reproduced is first scanned by a standard scanner and four color separations are created The original art is then edited to achieve the required metallic effect. Editing comprises the steps of creating a yellow mask, reviewing an electronic version of the image produced by the scanner, determining the amount of contrast between heavy and light metallic regions on the image by one skilled in the art based on past experience, and then sending that contrast information back to the scanner. A "yellow mask" is created to isolate areas where a metallic effect is desired. This "yellow mask" allows the operator to select these areas based on the color and tonal region of the original. For example, those areas appearing neutral are appropriate for silver metallic, while those areas appearing high yellow with a red component are appropriate for the gold metallic. Additional modification of dot size in these isolated areas may be required to avoid moire and reduction in metallic brilliance of the final colors. These colors can be printed at four screen angles: cyan (75°), magenta (45°), silver (45°), gold (75°), yellow (90°), and black (105°).

In the WIMS System, a cleaner, or more brilliant gold color ink is used, wherein the process color value is less than 25% for magenta and less than 5% for cyan. This should diminish any dirtiness caused by the process color values of adjacent primary colors. Additionally, any harsh edge effects caused during printing may be softened during the electronic masking stage. During printing, the silver separation can be printed at the same screen angle as the magenta, while the gold separation can be printed at the same screen angle as the cyan separation.

BRIEF DESCRIPTION OF THE DRAWINGS

For a more complete understanding of the present invention, and for further details and advantages thereof, reference is now made to the following Detailed Description taken in conjunction with the accompanying drawings, in which:

FIG. 1 illustrates a flow chart of the WIMS System for reproduction of metallic color; and

FIG. 2 illustrates a flow chart of the prior art MIPP System.

DETAILED DESCRIPTION OF THE DRAWINGS

The present invention relates to a metallic color printing process, also known as the WIMS System, that overcomes many of the disadvantages found in the prior art. Referring to FIG. 1, a flow chart illustrates the steps involved in the present method.

A first step involves pre-evaluation at step 10 of the subject to determine desired effects and proper placement of metallics in process reproduction. Metallic gold can be chosen at step 12, metallic silver can be chosen at step 14, or a combination of both metallic gold and metallic silver can be chosen at step 16. Next, the image can be scanned at step 18 by a scanner which, in turn, produces at step 20 four color separations which are electronically viewed on the scanner display. The scanner acts as both an input device and an output device. In other words, the artwork is input to the scanner. The scanner can then output color separations or film used to recreate the artwork. The scanning step involves the application of 75% to 100% to the scanner set-up and the scanning of the image. Then, the PCR is removed from the scanner set-up and the image is scanned to an "Imagedit", an electronic color correction machine, produced by the Crosfield Co. of Hemel Hempstead, England.

The original artwork is evaluated in a well known manner by one skilled in the art to determine the color areas in which the metallic effect is desired. A gold separation can be produced at step 22 by electronically selecting any color area where the effect is desired. Likewise, a silver separation can be produced at step 24 by electronically selecting any color area where the effect is desired. Typically, the cyan or black areas of the original art will be the basis for developing the silver printing whereas yellow or magenta areas of the original art will form the starting point for creating the gold printing. It is emphasized that either the gold or silver separations may be produced by selecting any color area where the effect is desired.

Using the Crosfield Imagedit, a "yellow mask" can then be created at step 26 to isolate the areas where a metallic effect is desired from the rest of the separation. The "yellow mask" function gives the ability to select the desired areas electronically based on the tonal region or bandwidth of the original as well as the desired color region. Creating a yellow mask entails several steps. First, an electronic version of the image produced by the scanner displays the contrast between a heavy metallic region and a light metallic region on the image. For example, neutrals are appropriate for silver, while high yellows with a red component are appropriate for gold. The yellow mask controls can be adjusted at step 28 to achieve desired printing strength (tonal range) of metallic inks within the yellow mask area. These controls allow the adjustment of slope, gain, and rolloff of the image within the yellow mask area.

Next, the Imagedit computer creates six revised color separations in a well-known manner; one each for yellow, cyan, magenta, black, gold and silver. Once these electronic masks are created, further modification at step 30 of the isolated area may be required. For example, such modifications may increase or reduce the printing dot size of the metallic separation and/or adjust at step 32 the amount of four color process ink printing over the newly created metallic to compensate for the reduction in brilliance caused by the additional metallic color in the reproduction. Additionally, in a given original, there may be areas of similar color where a metallic effect is desired in one area but not the other. For example, a gold watch requires a metallic gold, while a golden retriever would not. Due to this anomaly, further electronic manipulation of the image may be required to eliminate metallic ink in unwanted areas. Moreover, because all masking is performed electronically, it is possible to soften at step 34 any harsh edge effects in the final reproduction via mask smoothing or tonal integration techniques.

Next, this information is sent back to the scanner which outputs at step 36 the subtractive process colors and the metallic separations. The MIPP standard for screening is to eliminate (by hand masking) one of the process colors in metallic areas to free-up a screen angle, or to produce the metallic separations at a line screen resolution different than the process colors to reduce moire effects. However, in the WIMS process, the subtractive process colors are output at step 36 at 0°, 15°, and/or 30° screen angle intervals. An interval is the spacing between any two screen angles. The metallic color separations are output at step 38 at the same angles as the subtractive process colors or at 30° intervals. The gold separation can be produced at the same screen angle as the cyan separation. Likewise, the silver separation can be produced at the same angle as the magenta separation. Therefore, with WIMS reproductions, six colors can be printed at four screen angles. For example, cyan can be printed at 75°, magenta at 45°, silver at 45°, gold at 75°, yellow at 90°, and black at 105°. Both process and metallic separations are produced at the same line screen resolution. Typically, there are no problems with moire effect.

The next step involves metallic inks: a gold ink, a silver ink, or both gold and silver. The Pantone MIPP standard for gold ink is PMS 873. This ink printed solid has a process color value of approximately 65% yellow, 25% magenta and 5% cyan. For WIMS reproduction, however, a much more brilliant gold ink is used, wherein the magenta and cyan process equivalents are greatly reduced. This was selected under the rationale that a pure gold ink area of WIMS gold could be reduced in brilliance, but a pure PMS 873 ink area could not be made any more brilliant than the inherent bronze color of the ink. This same color compensation theory also applies to silver areas where a calculated reduction in cyan or black generally occurs.

Prepress proofing at step 40 is accomplished via a combination of 3M Matchprint II (for process colors) and Dupont Cromalin (for metallics). After proofing, the artwork is reproduced by first printing at step 42 the WIMS standard for silver, then printing at step 44 yellow, then printing at step 46 the WIMS standard for gold, and finally printing at step 48 the remaining subtractive primary colors in any order.

FIG. 2 provides a flow chart of the MIPP process which is discussed in greater detail in the Background Section. In sum, the designer marks up the artwork to be reproduced to show where MIPP is required and the image is scanned at step 118. Based on the object color in the original photograph and the color requirements of the final print, a determination is then made whether to choose at step 112 gold, choose at step 114 silver, or to choose at step 116 both silver and gold. The artwork is then scanned at step 118 by a scanner and a standard four-color separation is produced at step 120. Each separation is compared to the original to determine which gives the best representation of the metallic colors. A gold separation is next produced at step 122 using the screen angle of the process color that was eliminated in that area, as will be discussed in greater detail. Likewise, a silver separation can also be produced at step 124 using the screen angle of the process color that was eliminated in that area.

A green mask is created at step **126** with the scanner and viewed on the scanner display The overall contrast of the green mask can be adjusted at step **128** via the color correction controls. Shadow contrast can then be adjusted via undercolor removal (UCR) Next, the image is modified at step **130** to remove areas where the metallic effect is not required The level of the four subtractive process colors can be reduced at step **132** in the metallic printing area Mask edges can then be softened at step **134**.

Next, a screen angle must be freed at step **135** for each of the metallic inks to avoid problems of screen clash and resulting moire effects In other words, in any one area where a metallic ink is used, the subtractive primary color with the same screen angle must be eliminated or made solid. Thus, no more than four screened colors may appear in any one area of the reproduction The scanner outputs at step **136** the subtractive process colors to film at 30° and 15° intervals. The scanner can then output at step **137** the metallic separations at a screen angle of an eliminated process color. Alternatively, the scanner can output at step **138** the metallic separations at the screen angle of the eliminated process color but at a different dot shape and/or screen ruling than the four subtractive process colors Prepress proofing at step **140** is accomplished After proofing, the artwork is reproduced by first printing at step **142** the PMS 877 standard for silver, then printing at step **144** yellow, then printing at step **146** the PMS 873 standard for gold, and finally printing at step **148** the subtractive primary colors in any order.

Although preferred embodiments of the invention have been described in the foregoing Detailed Description and illustrated in the accompanying drawings, it will be understood that the invention is not limited to the embodiments disclosed, but is capable of numerous rearrangements, modifications, and substitutions of parts and elements without departing from the spirit of the invention Accordingly, the present invention is intended to encompass such rearrangements, modifications, and substitutions of parts and elements as fall within the scope of the invention.

We claim:

1 In a method of half-tone dot printing a reproduction of a scanned image on a substrate with the four subtractive process colors of magenta, cyan, yellow, and black in a given area of the scanned image at only four screen angles, an improved method of incorporating metallic colors in said reproduction, the improvement comprising the steps of:

- printing at least one metallic color in said given area at a selected one of the only four screen angles; and
- printing at least one of said four subtractive process colors in said given area at the same screen angle as said at least one metallic color such that said at least one metallic color and one process color are printed in said given area at the same one of said four screen angles so as to enable at least five colors to be printed at only said four screen angles.

2. A method as in claim 1 further including the steps of

- printing a second metallic color in said given area at a second one of said four screen angles; and
- printing a second one of said four subtractive process colors in said given area at the same second one of said four screen angles as said second metallic color so as to have an additional metallic color and an additional process color printed in said given area at said second one of said four screen angles so that up to six colors are printed at only said four screen angles

3 The method of claim 1 of reproducing a scanned image on a substrate including incorporating metallic colors and further comprising the steps of

- producing four process color separations of the scanned image, each at one of said four screen angles;
- producing at least one metallic color separation at the same screen angle as a corresponding first one of the four screen angles of the process color separations in said given area;
- editing each process color separation and the at least one metallic color separation to obtain metallic color separation information;
- outputting each process color separation to film creating a process color separation film;
- outputting the at least one metallic color separation to film creating a first metallic color separation film, and
- printing a reproduction of the scanned image on a substrate using the process color separation films and the at least one metallic color separation film such that both a metallic color separation and a process color separation are produced at the same screen angle.

4 The method of claim 3 of reproducing a scanned image on a substrate including metallic colors anti further comprising the steps of

- producing a second metallic color separation at the same screen angle as a corresponding second one of the four screen angles of the process color separations in said given area;
- editing the second metallic color separation to obtain metallic color separation information,
- outputting the second metallic color separation to film creating a second metallic color separation film, and
- printing a reproduction of the scanned image on a substrate using the process color separation film and the first and second metallic color separation films such that said first metallic color separation and a first process color separation are produced at an identical first screen angle and the second metallic color separation and second process color separation are produced at a second identical screen angle so as to enable up to six colors to be printed in the given area in only four screen angles.

5. The method of claim 4 wherein the step of producing a first and a second metallic color separation further comprises the steps of:

- producing a gold metallic color separation as the first metallic color separation; and
- producing a silver metallic color separation as the second metallic color separation.

6 The method of claim 4 wherein the step of producing a first and a second metallic color separation further comprises the steps of:

- producing a silver metallic color separation as the first metallic color separation, and
- producing a gold metallic color separation as the second metallic color separation.

7 The method of claim 4 wherein the step of editing further comprises the steps of:

- reviewing an electronic version of the scanned image to determine regions of the image where metallic color is to be added;

creating a yellow mask for the given area to enable isolation of any region therein where metallic color is to be printed;

electronically adjusting the amount of contrast between the isolated regions to achieve a desired metallic color contrast between said isolated regions so as to obtain metallic color separation information, and

sending the metallic color separation information back to the scanner to provide half-tone dot signals.

8. The method of claim 4 wherein the step of outputting the at least one metallic color separation further comprises the step of outputting the first metallic color separation at the same screen angle as a first process color separation or at a 0°, 15°, or 30° interval therefrom.

9. The method of claim 4 wherein the step of outputting the second metallic color separation further comprises the step of outputting the second metallic color separation at the same screen angle as a second process color separation or at a 0°, 15°, or 30° interval therefrom.

10. The method of claim 3 wherein the step of editing further comprises softening an image edge of the process color separations and metallic color separations.

11. The method of claim 3 wherein the step of outputting the process color separations comprises outputting the process color separations onto film at 0°, 15°, or 30° screen angle intervals.

12. The method of claim 1 wherein the step of printing comprises:

(a) printing the metallic silver onto the substrate,
(b) printing yellow onto the substrate;
(c) printing the metallic gold onto the substrate,
(d) printing the remaining colors onto the substrate in any order.

* * * * *

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W001126

14

Printing Research, Inc.
Mark-less Super Blue

August 31, 1994

Mr Jesse Williamson
Williamson Printing Corporation
6700 Denton Drive
Dallas, TX 75235

214-904-2100 (Phone)

Dear Jesse,

Further to our various conversations, we have enclosed product information and the following **Super Blue** proposal for installation on your:

1. **Heidelberg Speedmaster CD 102.** 7 color with coating tower, 40 inch press (Press being delivered 9-6-94).

We propose:

- A **Super Blue** HV High Velocity Hot Air Drying System for installation between printing units.
- A **Super Blue** ABII Air Blanket II 2KW Infra-Red Drying System for installation in the delivery. (PRI to deliver within 3 weeks of 9-6-94)

2. **Heidelberg Speedmaster CD 102**, 6 color with coating tower, 40 inch press (Press being delivered the week of 9-27-94).

We propose:

- A **Super Blue** HV High Velocity Hot Air Drying System for installation between printing units.
- A **Super Blue** ABII Air Blanket II 2KW Infra-Red Drying System for installation in the delivery.

3. **Heidelberg Speedmaster CD +L+Y+L 102**, 6 color with coating tower (L), with dummy unit for drying (Y), with second coating tower (L). 40 inch press (Press being delivered January '95).

We propose:

W001127

- A **Super Blue** HV High Velocity Hot Air Drying System for installation between printing units.
- A **Super Blue** ABII Air Blanket II 2KW Infra-Red Drying System for installation in the delivery
- A **Super Blue** CUV 'Cold' UV Drying System for installation in the delivery.

4A. **Heidelberg Speedmaster CD 102**, 8 color with coating tower, 40 inch press

B. **Heidelberg Speedmaster CD 102**, 8 color with coating tower, 40 inch press (Both presses being delivered June/July 1995).

We propose:

- A **Super Blue** HV High Velocity Hot Air **Drying System** for installation between printing units.
- A **Super Blue** ABII Air Blanket II 2KW Infra-Red Drying System for installation in the delivery

We look forward to serving your needs and thank you for your interest in our **Super Blue** range of products. For more information please contact us at 1-800-627-5537.

Sincerely yours,

John Bird
Product Manager

JB:rj

Enclosures: PI/FAB

cc: Bill Davis - Williamson Printing Corp.
Bob Emrick - Williamson Printing Corp.

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W001128

15

Printing Research, Inc.
"Mark-less" Super Blue®

September 6, 1994

Mr. Jesse Williamson
Williamson Printing Corporation
6700 Denton Drive
Dallas, TX 75235

214-904-2100 (Phone)

Dear Jesse,

It was a great pleasure for Howard and me to meet with you, Woody, Bill and Bob. The following confirms the major points discussed and agreed:

Press Purchase 1. Heidelberg Speedmaster CD102, 7 color with coating tower, 40 inch press. PRI equipment to be supplied:

- A **Super Blue** HV High Velocity Hot Air Drying System for installation between printing units.
- A **Super Blue** ABII Air Blanket II 2KW Infra-Red Drying System for installation in the delivery.

Special Conditions:

A. Purchase, delivery, installation and training charges are waived for drying system 1.
B. PRI to install HV when Williamson Printing Corporation (WPC) signs off on press.
C. In the unlikely event that PRI fails to dry water based coatings applied in line over 7 colors, we will remove our equipment and purchase a Grafix drying system as previously proposed by Heidelberg.

Press Purchase 2: Heidelberg Speedmaster CD 102, 6 color with coating tower, 40 inch press. PRI equipment to be purchased:

- A **Super Blue** HV High Velocity Hot Air Drying System for installation between printing units.
- A **Super Blue** ABII Air Blanket II 2KW Infra-Red Drying System for installation in the delivery.

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W001129

Press Purchase 3: Heidelberg Speedmaster CD 102 L+Y+L, 6 color with coating tower (L) with dummy unit for drying (Y) and with second coating tower (L) 40 inch press. PRI equipment to be purchased:

- A **Super Blue** HV High Velocity Hot Air Drying System for installation between printing units.
- A **Super Blue** ABII Air Blanket II 2KW Infra-Red Drying System for installation in the delivery.
- A **Super Blue** CUV 'Cold' UV Drying System for installation in the delivery.

Press Purchase 4: Heidelberg Speedmaster CD 102, 8 color with coating tower 40 inch press:

- A **Super Blue** HV High Velocity Hot Air Drying System for installation between printing units.
- A **Super Blue** ABII Air Blanket II 2KW Infra-Red Drying System for installation in the delivery.

Press Purchase 5: Heidelberg Speedmaster CD 102, 8 color with coating tower 40 inch press:

- A **Super Blue** HV High Velocity Hot Air Drying System for installation between printing units.
- A **Super Blue** ABII Air Blanket II 2KW Infra-Red Drying System for installation in the delivery.

Special Conditions:

A. We have discounted the total PRI drying equipment price of $528,956 by supplying WPC the drying equipment for Press Purchase 1 at no charge and by allowing a further discount of 20% against the drying equipment for Press Purchases 2, 3, 4, 5.
B. We are supplying three recommended spare parts systems at no charge, all three of which to be supplied with PRI equipment for press purchases 1, 2, and 3.
C. We are extending our standard warranty conditions, Paragraph 3 'Terms of Proposal', Paragraph 6 'Sales Terms and Conditions' from 12 months to 24 months.

The following represents our estimated installation costs:

Press Purchase 1: No charge.
Please note: There will be three exhaust terminations at the press to be completed by the customer. Two PRI and one Heidelberg pan exhaust.

Press Purchase 2:

Delivery, installation and training costs priced at:	
18 man days at $400 per day or	$ 7,200
Equipment interconnection costs	
including materials and 4 man days at	$ 3,600
Total cost:	$10,800

Please note: There will be three exhaust terminations at the press to be completed by the customer, two PRI and one Heidelberg pan exhaust.

Press Purchase 3:

Delivery, installation and training costs priced at:	
34 man days at $400 per day or	$13,600
Equipment interconnection costs	
including plumbing materials and 8 man days at	$11,400
Total cost:	$25,000

Please note: There will be five exhaust terminations at the press to be completed by the customer, four PRI and one Heidelberg pan exhaust.

Press Purchase 4:

Delivery installation and training costs priced at:	
20 man days at $400 per day or	$ 8,000
Equipment interconnection costs	
including materials and 5 man days at	$ 4,300
Total cost:	$12,300

Please note: There will be three exhaust terminations at the press to be completed by the customer, two PRI and one Heidelberg pan exhaust.

Press Purchase 5:

Delivery installation and training costs priced at:	
20 man days at $400 per day or	$ 8,000
Equipment interconnection costs	
including materials and 5 man days at	$ 4,300
Total cost :	$12,300

Please note: There will be three exhaust terminations at the press to be completed by the customer, two PRI and one Heidelberg pan exhaust.

Total turnkey price to install all PRI equipment on five presses, therefore: **$60,400.**

Special notes: All above pricing is estimated on the basis of I. Control cabinets and interconnecting is no more than 10 feet from the side of the press. II. Overhead runs of cables etc.. to be no more than 15 feet from the floor line.

We look forward to serving your needs and thank you for your interest in our **Super Blue** range of products. For more information please contact us at 1-800-627-5537.

Sincerely yours,

John Bird
Product Manager

JB:tj

cc: Woody Dixon - Williamson Printing Corporation
Bill Davis - Williamson Printing Corporation
Bob Emrick - Williamson Printing Corporation

16

Printing Research, inc.
"Mark-less" Super Blue®

September 6, 1994

Mr. Jesse Williamson
Williamson Printing Corporation
6700 Denton Drive
Dallas TX 75229

Dear Jesse:

Pursuant to Paragraph 2 of the Settlement Agreement dated October 1, 1993, among Printing Research, Inc. (PRI), Howard W. DeMoore (HWD), Williamson Printing Corporation (WPC), Jerry B. Williamson, III, Jesse Speight Williamson and Buford Roy Williams, WPC agreed to purchase goods and services from PRI on the terms set forth therein. PRI has recently submitted to WPC a proposal pursuant to which PRI would sell certain goods and services to Heidelberg USA for inclusion in printing presses to be purchased by WPC.

This letter will acknowledge and confirm that the sale by PRI to Heidelberg USA of the ABII Air Blanket II 2KW Infrared Dryer as described in Proposal I dated August 31, 1994, for inclusion in the Heidelberg CD102, 7-color with coating tower, 40-inch press to be purchased by WPC, will constitute full and complete satisfaction by WPC of Paragraph 2 of the Settlement Agreement. The terms and provisions of Paragraph 2 of the Settlement Agreement will be deemed fully and completely satisfied by WPC upon PRI's receipt of a binding purchase order from Heidelberg USA for the ABII Air Blanket II 2KW Infrared Dryer regardless of whether such drying system is ultimately accepted by WPC after installation and testing pursuant to the terms of WPC's contract with Heidelberg USA.

PRI further agrees that, in the event the ABII 2KW Infrared Dryer is not ultimately accepted by WPC after installation and testing pursuant to the terms of WPC's contract with Heidelberg USA, PRI will replace such drying system with the Grafix Dryer originally specified for the press at no charge to WPC.

Best regards,

Howard W DeMoore

Howard W. DeMoore,
As President and Individually

HWD:ln

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W001133

17

Printing Research, Inc.
"Mark-less" Super Blue®

TELEFAX MESSAGE FROM PRINTING RESEARCH, INC.

REF FAX NR	:	**915jb1**	
DATE	:	**September 15, 1994**	**PAGE 1 OF 4**
COMPANY	:	**WILLIAMSON PRINTING CORP.**	
ATTN	:	**BILL DAVIS**	

Dear Bill,

Please find the attached letter from Printing Research. Please feel free to contact us if you have any questions. Thank you.

Best Regards,

John Bird
Product Manager

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W001134

10954 Shady Trail Dallas, Texas 75220 U.S.A. Telephone 214-353-9000 Telex 794028 Superblue dal Fax 214-357-5847

Printing Research, Inc.
"Mark-less" Super Blue®

September 15, 1994

Mr. Jesse Williamson
Williamson Printing Corporation
6700 Denton Drive
Dallas, TX 75235
214-904-2100 (Phone)

Dear Jesse,

The following confirms our various conversations and the final purchase agreement schedule:

Press Purchase 1. Heidelberg Speedmaster CD102, 7 color with coating tower, 40 inch press. PRI equipment to be supplied:

- A **Super Blue** HV High Velocity Hot Air Drying System for installation between printing units.
- A **Super Blue** ABII Air Blanket II 2KW Infra-Red Drying System for installation in the delivery.

Special Conditions:

A. Purchase, delivery, installation and training charges are waived for drying system 1.
B. PRI to install HV when Williamson Printing Corporation (WPC) signs off on press.
C. In the unlikely event that the PRI drying system fails to dry water based coatings applied in line over 7 colors to Williamson Printing Corporation's sole satisfaction or if the system is detrimental in any way to the press or process as determined by Williamson Printing Corporation, we will remove our equipment and purchase a Grafix drying system as previously proposed by Heidelberg at no cost to Williamson.

Equipment Cost:	$81,173
Discount:	<u>$81,173</u>
	NO CHARGE
Spare Parts, Delivery, Installation, Interconnect, Training	NO CHARGE

Press Purchase 2: Heidelberg Speedmaster CD 102, 6 color with coating tower, 40 inch press. PRI equipment to be purchased:

- A **Super Blue** HV High Velocity Hot Air Drying System for installation between printing units.
- A **Super Blue** ABII Air Blanket II 2KW Infra-Red Drying System for installation in the delivery.

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Equipment Cost:	$73,281
Less 20%:	<u>$14,656</u>
	$58,625
Plus - Spare Parts (Box of 10 Lamps)	NO CHARGE
Plus - Delivery, Installation & Training	<u>$ 7,200</u>
	$65,825

W001135

Press Purchase 3: Heidelberg Speedmaster CD 102 L+Y+L, 6 color with coating tower (L) with dummy unit for drying (Y) and with second coating tower (L) 40 inch press. PRI equipment to be purchased:

- A **Super Blue** HV High Velocity Hot Air Drying System for installation between printing units.
- A **Super Blue** ABII Air Blanket II 2KW Infra-Red Drying System for installation in the delivery.
- A **Super Blue** CUV 'Cold' UV Drying System for installation in the delivery. Note: Utilizes WPC Chill Water System.

Equipment Cost:	$181,216
Less 20%:	$ 36,243
	$144,973
Plus - Spare Parts (Box of 10 IR Lamps), 3 UV Lamps, 2 Filter Tubes, Deionizing Resin	NO CHARGE
Plus - Delivery, Installation & Training	$ 13,600
	$158,573

Press Purchase 4: Heidelberg Speedmaster CD 102, 8 color with coating tower 40 inch press:

- A **Super Blue** HV High Velocity Hot Air Drying System for installation between printing units.
- A **Super Blue** ABII Air Blanket II 2KW Infra-Red Drying System for installation in the delivery.

Equipment Cost:	$ 89,023
Less 20%:	$ 17,805
	$ 71,218
Plus - Delivery, Installation & Training	$ 8,000
	$ 79,218

Press Purchase 5: Heidelberg Speedmaster CD 102, 8 color with coating tower 40 inch press:

- A **Super Blue** HV High Velocity Hot Air Drying System for installation between printing units.

- A **Super Blue** ABII Air Blanket II 2KW Infra-Red Drying System for installation in the delivery.

Equipment Cost:	$ 89,023
Less 20%:	$ 17,805
	$ 71,218
Plus - Delivery, Installation & Training	$ 8,000
	$ 79,218

Special Conditions:

A. We have discounted the total PRI drying equipment price of $528,956 by supplying WPC the drying equipment for Press Purchase 1 at no charge and by allowing a further discount of 20% against the drying equipment for Press Purchases 2, 3, 4, 5.
B. We are supplying three recommended spare parts systems at no charge, all three of which to be supplied with PRI equipment for press purchases 1, 2, and 3.
C. We are extending our standard warranty conditions, Paragraph 3 'Terms of Proposal', Paragraph 6 'Sales Terms and Conditions' from 12 months to 24 months.

If this document represents your understanding of our agreement, please initial and return a copy. We thank you for your order and confidence in PRI and look forward to Partnering in Progress.

Sincerely yours,

John

John Bird
Product Manager

JB:tj

cc: Bill Davis - Williamson Printing Corporation
Woody Dixon - Williamson Printing Corporation

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W001137

18

Printing Research, Inc.
"Mark-less" Super Blue*

December 16, 1994

Mr. Bill Davis
Williamson Printing Corporation
6700 Denton Drive
Dallas TX 75229

Dear Bill,

We have enclosed drawings showing the 5 Heidelberg Speedmaster CD press configurations ordered by yourselves.

We look forward to our test runs on the Super Blue EZ Blanket Coater next week.

Sincerely yours,

John Bird
Product Manager

JB:ln

Enclosures: DWG

cc: Steve Baker

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W001138

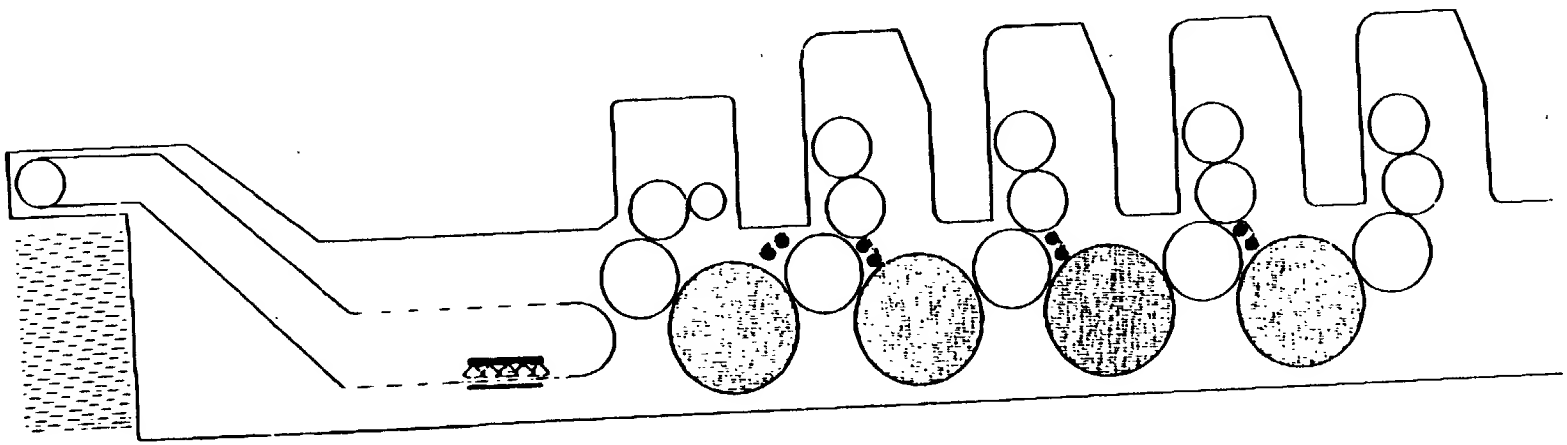
10954 Shady Trail Dallas, Texas 75220 U.S.A. Telephone 214-353-9000 Telex 794028 Superblue dal Fax 214-357-5847

Williamson Printing Corporation

Press No. 1, 2, 4 & 5

Heidelberg Speedmaster CD

with Coating Tower and Extended Delivery



Legend:

- Super Blue® Wash-Free Anti-Marking Cylinder
- Super Blue® Air Blanket Infrared Dryer
- Super Blue® High Velocity Hot Air Dryer

Printing Research, Inc.

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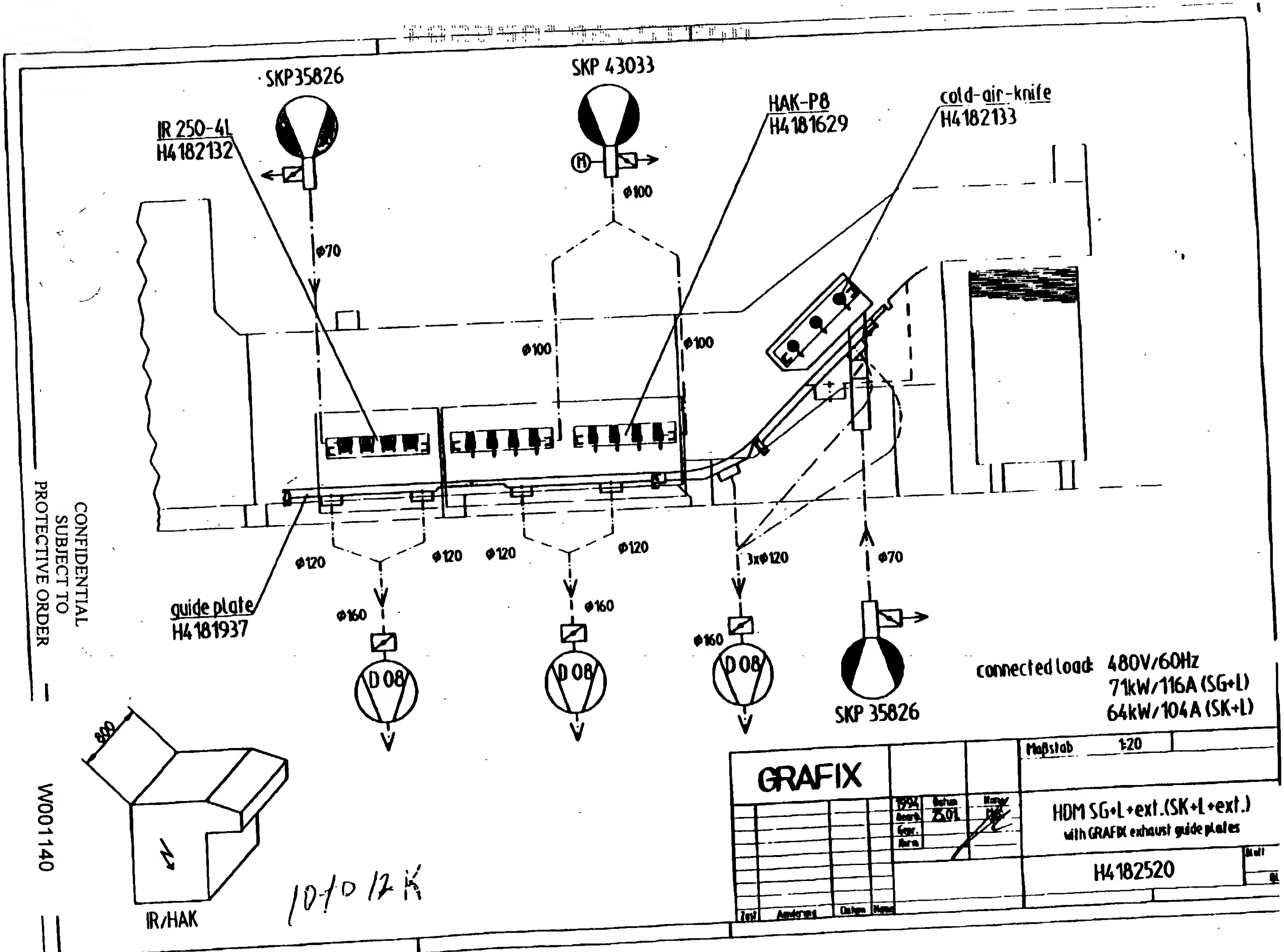

10/10 12 K

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W001140

19

Printing Research, Inc.
"Mark-less" Super Blue"

January 25, 1995

Mr. Jesse Williamson
Williamson Printing Corporation
6700 Denton Drive
Dallas TX 75235

214-904-2100 (Phone)

Dear Jesse,

It was a great pleasure speaking with you. We have enclosed product information and the following **Super Blue** proposal for installation on your:

Heidelberg 102CD+L+Y+L, 6 color, 40 inch press with extension

We propose:

- **A Super Blue EZB Blanket Coater for installation at the blanket cylinder.**

The benefits to you of installing the **Super Blue Coater System** are as follows:

- Automatic recirculation system
- Automated wash up procedure
- Consistent overall coating weight
- Sealed doctor blade assembly
- Totally independent of dampening system
- Elimination of lengthy wash up procedures

We look forward to serving your needs and thank you for your interest in our **Super Blue** range of products. For more information please contact us at 1-800-627-5537.

Sincerely yours,

Steve Baker

Steve Baker
District Sales Manager

SB:nw

Enclosures: PI/PRO/DWG

cc: Bill Davis - Williamson Printing Corporation
John Bird
Steve Garner

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W001141

20

W F & U

Printing Research, Inc.

"Mark-less" Super Blue®

February 16, 1995

Mr. Jesse Williamson
Williamson Printing Company
6700 Denton Drive
Dallas, Texas 75235

214-904-2100 (Phone)

Dear Jesse,

Further to our meeting of 2-11-95 we confirm the following:

1. We are producing an experimental EZ interstation flexo printer coater for installation on your Heidelberg Speedmaster CD 6 color + LYL, 40 inch press with a target to be installed and operational date of March 15, 1995. This unit for adaptation to the first coating tower of the LYL.

2. The experimental EZ coater will have a coating face length of 39.5 inches. Production models for the Coater position 'L' will have a coating face length of 40.55 inches and for interstation printing unit positions will have a coating face length of not less than 38 inches.

3. The experimental EZ coater will be supplied at no charge to Williamson Printing Company. We anticipate that this unit will be replaced by a production unit at a later date.

4. We have enclosed updated proposals for Super Blue EZ interstation flexo printer coaters for installation on your Heidelberg Speedmaster CD presses.

We look forward to serving your needs and thank you for your interest in our Super Blue range of products. For more information please contact us at 1-800-627-5537.

Sincerely yours,

John Bird
Product Manager

JB:tj

cc: Bill Davis - Williamson Printing Company
Howard DeMoore
Steve Garner
Ed Schaffler
Dave Douglas
Steve Baker

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W001142

10954 Shady Trail Dallas, Texas 75220 U.S.A. Telephone 214-353-9000 Telex 794028 Superblue dal Fax 214-357-5847

21

SUPER BLUE

THE EZ PRINT/ COAT FAMILY

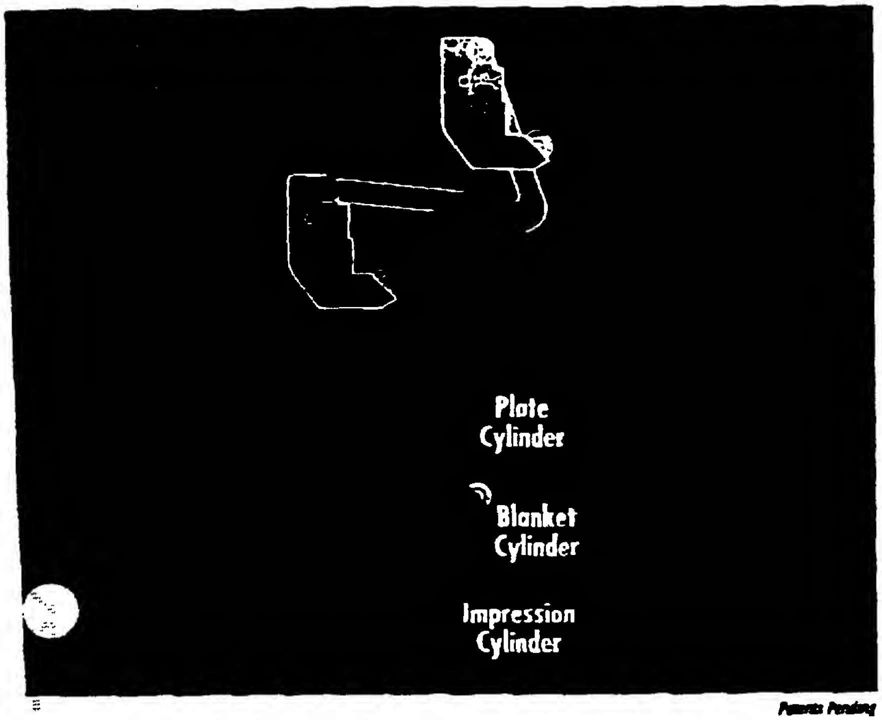
MAXIMUM FLEXOBILITY AND A TOUCH OF BRILLIANCE

SUPER BLUE

THE EZ PRINT/ COAT FAMILY

MAXIMUM FLEXOBILITY AND A TOUCH OF BRILLIANCE

Add Innovative In-Line Interstation and End of Press Printing Coating.



The Super Blue EZ Interstation Flexo Printer/Coater is installed directly onto a print unit, for applying any one of a number of aqueous or UV based metallic/opaque inks between print units.

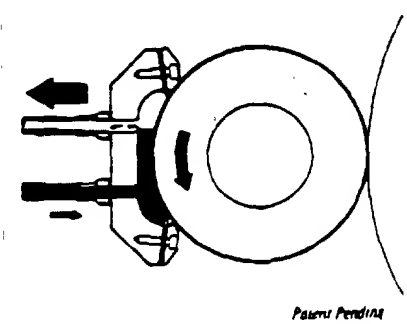
Have you ever wanted to add in-line coating capabilities, metallic, opaque, or other specialized applications to specific print units? Was your decision not to enter this market influenced by mediocre quality, undesirable environmental considerations, or the prohibitive cost?

Search no more ... Your needs and concerns have been resolved!

Printing Research, Inc., invites you to review the patented family of EZ Print/Coat products as described in this brochure. We are confident that you will find the perfect solution to your present and future printing demands.

EZ Interstation Flexo Printer/Coater

The Super Blue EZ Interstation Flexo Printer/Coater is retractable so that it can be swung up and above the print unit for conventional printing or swung into the blanket position to offer complete application variations from job to job. The patented coating head assembly is comprised of two main components. A combination of engraved anilox rolls are offered to provide a consistent overall ink/coating weight. The anilox rolls yield excellent ink/coating release and lay characteristics with no fear of plugging, leaking, or misting due to the unique enclosed doctor blade assembly.



The EZ Print/Coat Family utilizes a universal coating head configuration for superior ink and coating transfer.

W001145

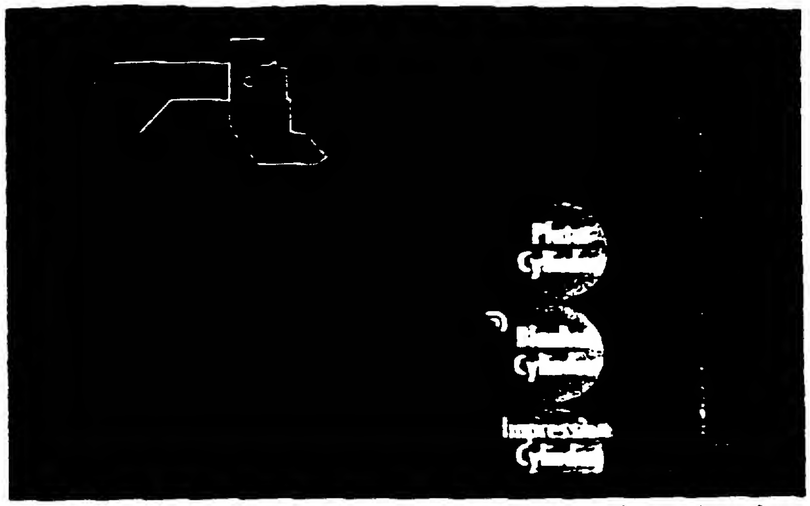
EZ Blanket Coater

The Super Blue EZ Blanket Coater is mounted such that the coating head can be automatically removed from its coating position for conventional use of the last print unit as well as full operator access. Although the EZ Blanket Coater is an end of press retrofit, it offers the same coating release and lay characteristics without fear of plugging, leaking, or slinging due to the same unique enclosed doctor blade assembly.

EZ Automatic Pump and Recirculation System

The Super Blue EZ Automatic Pump and Recirculation system is designed to eliminate the headaches associated with other pump systems and complicated wash-up procedures that impact your production time and bottom line. The circulation system is a standard component that allows the operator to push a button and walk away. Whether you are purging, coating, washing-up or by-passing each is fully automated and timed. In addition, the clean-up water reservoir is heated to provide optimum line and head cleaning.

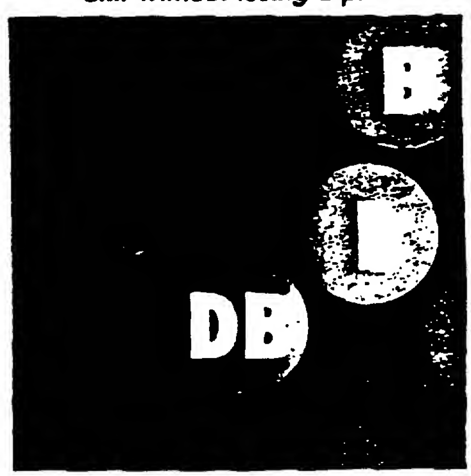
The Super Blue EZ Automatic Pump and Recirculation System is offered as a separate product to suit most anilox coating systems, whether it be a blanket coater, tower coater, flexographic coater or web coater.



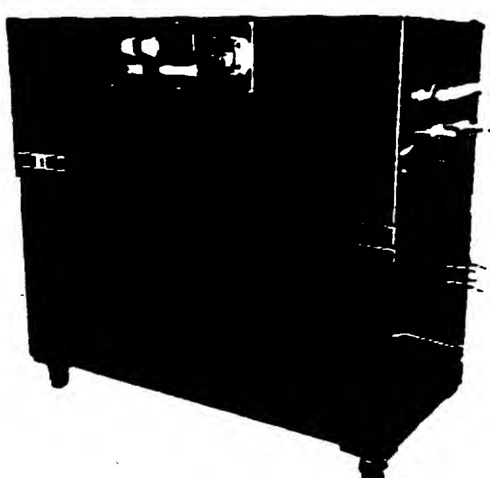
Patented and Patents Pending

The Super Blue EZ Blanket Coater is installed directly onto the delivery or coating/dummy unit of your press for applying any one of a number of aqueous or UV coatings or inks at the last print unit blanket cylinder.

The Super Blue EZ Impression Cylinder Coater is installed between the gripper chain rails of the press delivery, but utilizes its own delivery blanket cylinder to add a coating unit without losing a print unit.

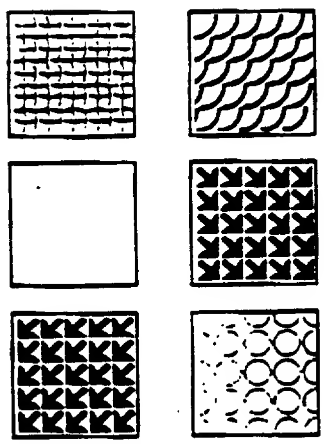


Patented



Patented

The Super Blue EZ Automatic Pump and Recirculation System is common to the entire EZ Print/Coat Family as a standard component.



SUPER BLUE®

Printing Research, Inc.

10954 Shady Trail Dallas, Texas 75220 U.S.A.
Telphone: 214-353-9000
Telex: 794028 Superblue dal
Fax: 214-357-5847
1-800-MARK-LESS
(1-800-627-5537)

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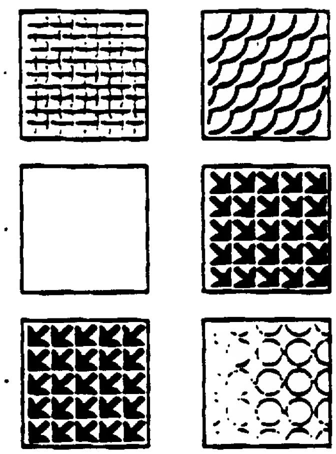
Another Fine Product From The Makers Of The Patented Super Blue® System

W001147



SUPER BLUE®

Printing Research, Inc.

10954 Shady Trail Dallas, Texas 75220 U.S.A.
Telphone: 214-353-9000
Telex: 794028 Superblue dal
Fax: 214-357-5847
1-800-MARK-LESS
(1-800-627-5537)

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Another Fine Product From The Makers Of The Patented Super Blue® System

Instant-drying inks and the elimination of spray powder have been the dream of every printer and printing buyer. The idea was put forward in the 1970's and 80's that it would be possible to print with conventional inks and apply a coating which would dry completely before placement on the delivery stack. This would place a dry skin over the ink, eliminating offsetting, sheet marking and the need for spray powder. The inks dry under the coating.

The advent of the 90's has made the dream a reality. It is now possible to print superior quality with conventional inks and coat the surface in order to deliver a dry, mark-free sheet at full production speeds. This is what the Super Blue products from Printing Research accomplish for you.

Printing Research, Inc.

10954 Shady Trail Dallas, Texas 75220 U.S.A.

Telephone 214-353-9000
Telex 794028 Superblue dal
Fax 214-357-5847

Patented

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Printing Research, inc.
"Mark-less" Super Blue®

May 12, 1995

Mr. Jerry Williamson
Williamson Printing Corp.
6700 Denton Drive
Dallas TX 75235-4497

Dear Jerry,

It was a great pleasure for Steve Garner and me to meet with you, Jesse Williamson and Bill Davis. The following confirms our discussion:

1. **EZ Interstation Flexo Printer/Coater**

   A. Lithoflex as used by PRI to describe its EZ Printer/Coater process is not in conflict with WPC.

   B. PRI is preparing comment for an upcoming coating article in <u>Graphic Arts Monthly</u> relative to the EZ Printer/Coater family, as well as a presentation for the GATF Sheetfed Conference June 25-27, 1995. Both GAM and GATF would like input from WPC. We are suggesting that they both contact you direct.

   C. An order for one Super Blue EZ Interstation Flexo Printer/Coater (your PO 3315) for installation on the first printing unit of your Heidelberg Speedmaster CD 6+LYL is in hand. We anticipate delivery to be approximately 90 days. The price of the coater is to be negotiated. WPC will continue to use PRI's experimental coater installed on the Heidelberg Speedmaster CD 7+L press until PRI has delivered and installed the EZI.

   D. A separate discussion document addressing exclusivity is attached.

2. **Heidelberg Speedmaster CD 6+LYL (Press #3)**

   A. Gloss readings have been taken of the spot water based primer UV overcoat printing job that had various products (golf club, sports shoe, electrical connectors, etc.). The findings are as follows:
      1. Highlight areas -- 97 points (toe of shoe)
      2. Heavy black solids -- 74 points (electrical connectors)
      3. Solid blue -- 84 points (credit card)

We all concluded that this was a classic case of dry back and that we should press forward with the installation of HV on this press to alleviate such dry back problems and also to dry metallic or specialist water based inks in the future.

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B. The UV lamps in the upsweep of the delivery are to be moved to the lower last horizontal aperture in the extended delivery to:
   1. Minimize spray powder contamination when running spot UV applications
   2. Minimize the effects of sheet flutter on the cure of UV coatings. This needs to be carried out as soon as is convenient to WPC.

3. **Heidelberg Speedmaster CD 8+L (Press #5)**

A. This press is to be supplied UV ready for maximum flexibility. All indications up to this point are that the water based flexo metallic, even when thoroughly dry, will be prone to pile and back trap when applied on early units of a press. The application of UV metallic appears to overcome this problem. The installation of UV throughout would enable WPC to print litho, flexo on any unit, assuming EZ Flexo Printer Coaters were installed, on any substrate at maximized press speeds.

B. PRI is to furnish WPC with a proposal for an 11 lamp 'Cold' UV system for this press.

4. **Web Offset 38 Inch UV Coating System**

A. PRI is to arrange a visit for WPC to Sheffer's installation of a UV coater on a Heidelberg Harris M1000 in Portland, Tennessee.

B. PRI is to prepare a proposal for a joint Sheffer/PRI coater package for installation on WPC's newly proposed press.

We look forward to a continued successful partnership.

Sincerely yours,

John Bird

John Bird
Product Manager

JB:ln

Enclosures:

cc: Jesse Williamson/Williamson Printing Corp.
Bill Davis/Williamson Printing Corp.
Bob Emrick/Williamson Printing Corp.
Steve Garner/PRI
Steve Baker/PRI

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Printing Research, inc.
"Mark-less" Super Blue®

WPC/PRI PARTNERING AGREEMENT FOR THE SUPER BLUE EZ INTERSTATION FLEXO PRINTER/COATER

①
②

1. PRI agrees to manufacture and supply one Super Blue EZ Interstation Flexo Printer/Coater (PO #3315) on an exclusive basis.

2. Exclusive is to be interpreted to mean that PRI will not supply to printers in the commercial litho offset printing market for a period and territory to be defined.

3. Exclusions include the litho offset printing markets of folding carton, label, and greeting cards.

   A. North America, including Mexico and Canada, will be exclusive to WPC for ~~6~~ 12 months from the date of delivery of the EZ Interstation Flexo Printer/Coater (PO #3315).

   B. Texas and its contiguous states (Louisiana, Arkansas, Oklahoma, New Mexico) and including Arizona and Colorado will be exclusive for a further 6 months, equaling 12 months from the date of delivery of the EZ Interstation Flexo Printer/Coater. 2/1

4. PRI defines 6 months and 12 months exclusivity 3A and 3B to mean PRI will not accept an order for a Super Blue EZ Interstation Flexo Printer/Coater for installation on a printing unit prior to the last printing unit of a press.

5. PRI may request during the term of this agreement to supply to other commercial printers and WPC may ~~not unreasonably~~ decline.

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US005598777A

United States Patent [19]

DeMoore et al.

[11] Patent Number: 5,598,777

[45] Date of Patent: Feb. 4, 1997

[54] RETRACTABLE PRINTING/COATING UNIT OPERABLE ON THE PLATE AND BLANKET CYLINDERS

[75] Inventors: **Howard W. DeMoore**, 10954 Shady Trail, Dallas, Tex. 75220; **Ronald M. Rendleman**, Dallas; **John W. Bird**, Carrollton, both of Tex.

[73] Assignee: **Howard W. DeMoore**, Dallas, Tex.

[21] Appl. No.: **538,274**

[22] Filed: **Oct. 2, 1995**

[51] **Int. Cl.**[6] **B41F 5/02**; B41F 5/22; B41F 31/36

[52] **U.S. Cl.** **101/177**; 101/352

[58] **Field of Search** 101/349, 350, 101/351, 352, 207, 208–210, 363, 364, 147, 148, 143, 144, 217, 218, 177, 247; 118/258–262, 46, 263

[56] **References Cited**

U.S. PATENT DOCUMENTS

4,308,796 1/1982 Satterwhite 101/350

4,706,601 11/1987 Jahn 118/211

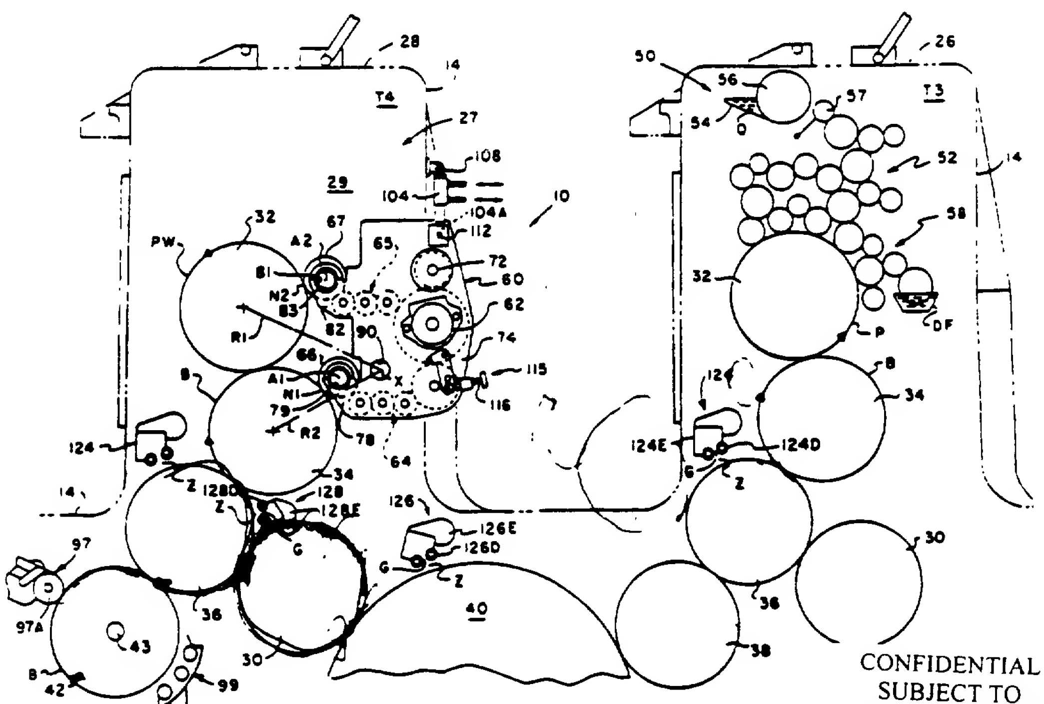
Primary Examiner—J. Reed Fisher

Attorney, Agent, or Firm—Sidley & Austin

[57] **ABSTRACT**

A retractable in-line inking/coating apparatus can apply either spot or overall inking/coating material to a plate and/or a blanket on the first printing unit or on any consecutive printing unit of any rotary offset printing press. The inking/coating apparatus is pivotally mounted within the conventional dampener space of any lithographic printing unit. The aqueous component of the flexographic printing ink or aqueous coating material is evaporated and dried by high velocity, hot air dryers and high performance heat and moisture extractors so that the aqueous or flexographic ink or coating material on a freshly printed or coated sheet is dry and can be dry-trapped on the next printing unit. The inking/coating apparatus includes dual cradles that support first and second applicator rollers so that the inking/coating apparatus can apply a double bump of aqueous/flexographic or UV-curable printing ink or coating material to a plate on the plate cylinder, while simultaneously applying aqueous, flexographic or UV-curable printing ink or coating material to a plate or a blanket on the blanket cylinder, and thereafter onto a sheet as the sheet is transferred through the nip between the blanket cylinder and the impression cylinder. A triple bump is printed or coated on the last printing unit with the aid of an impression cylinder inking/coating unit.

19 Claims, 10 Drawing Sheets



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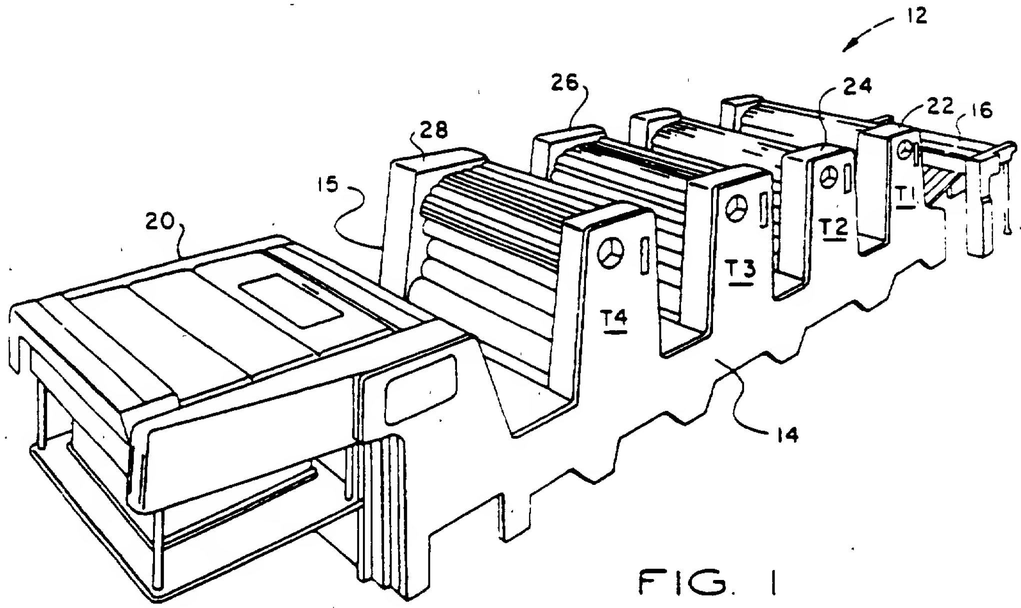
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T3
T4
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FIG. 1

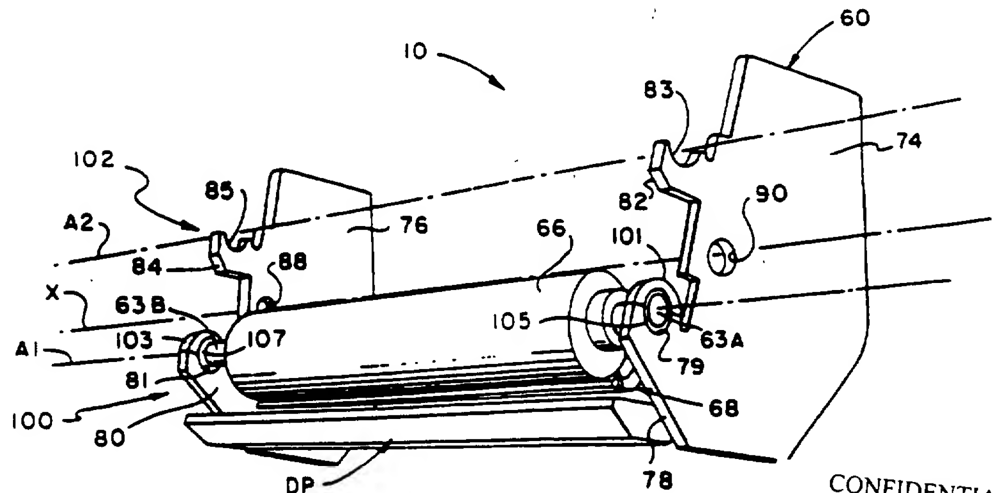
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FIG. 2

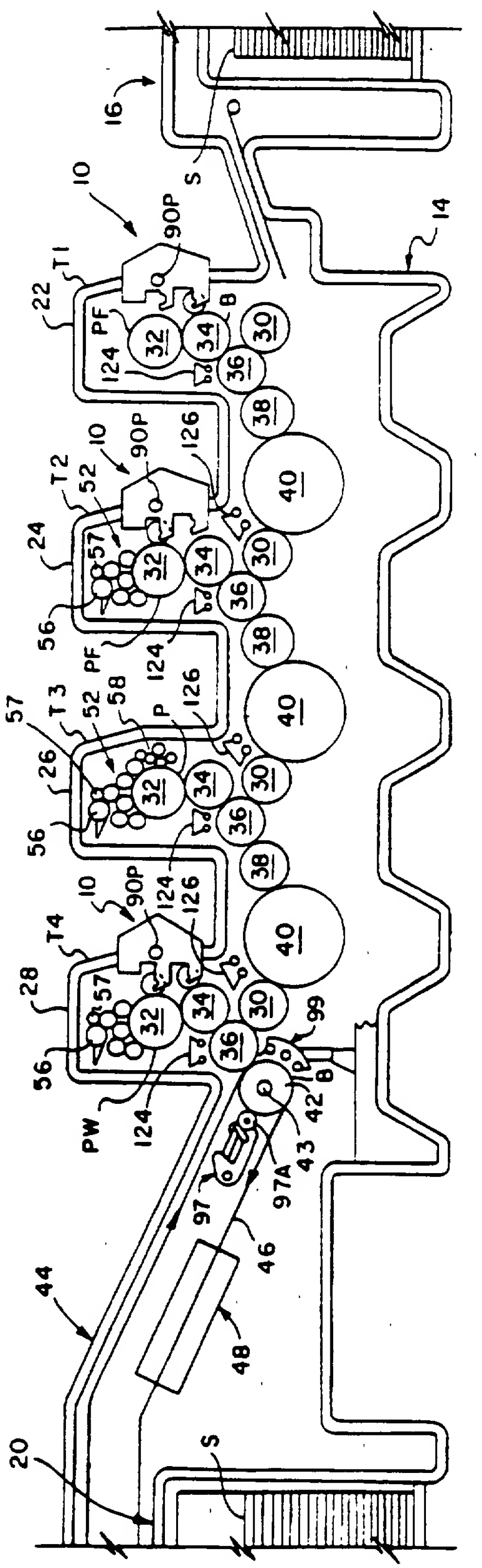
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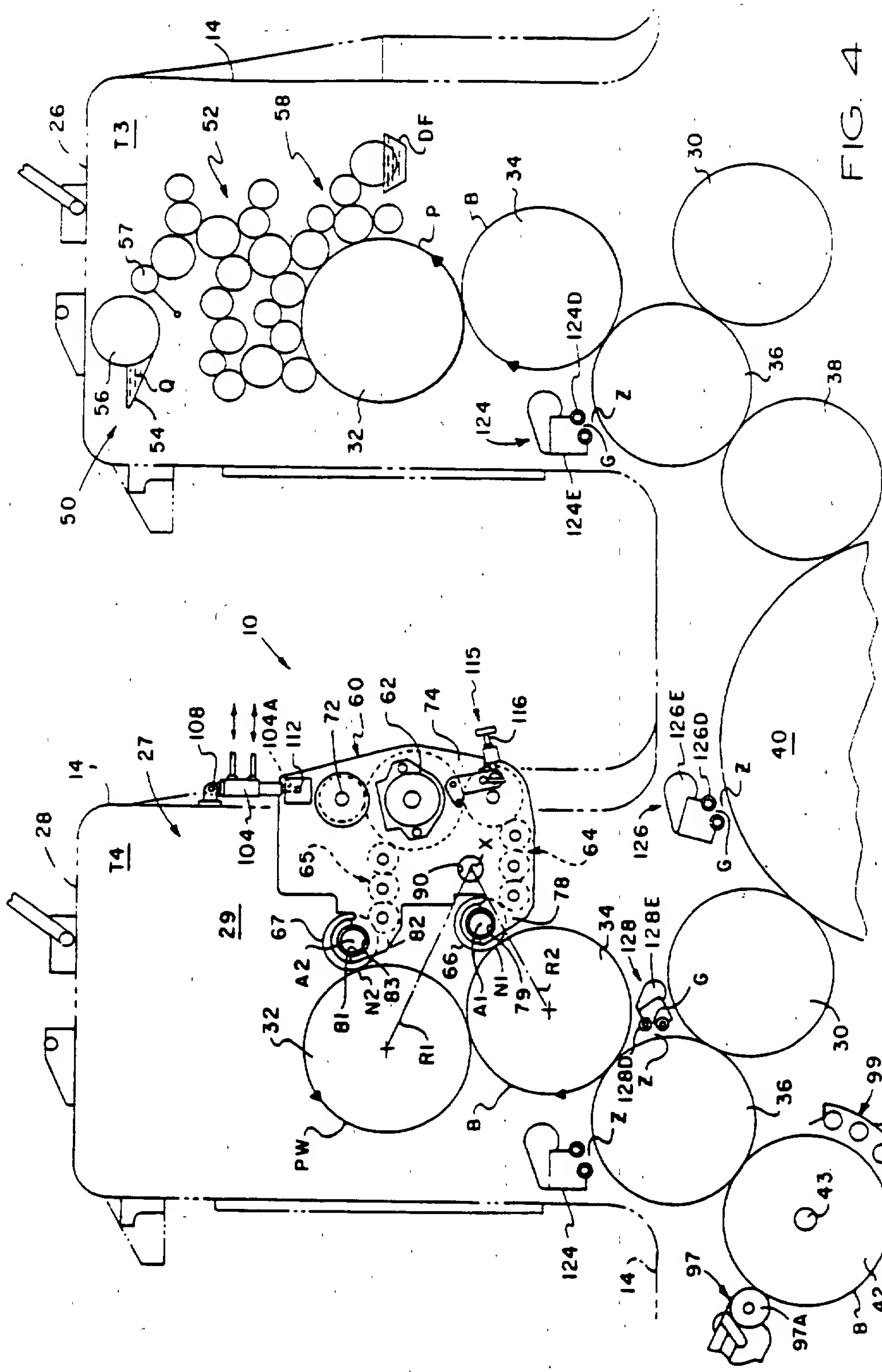
FIG. 3



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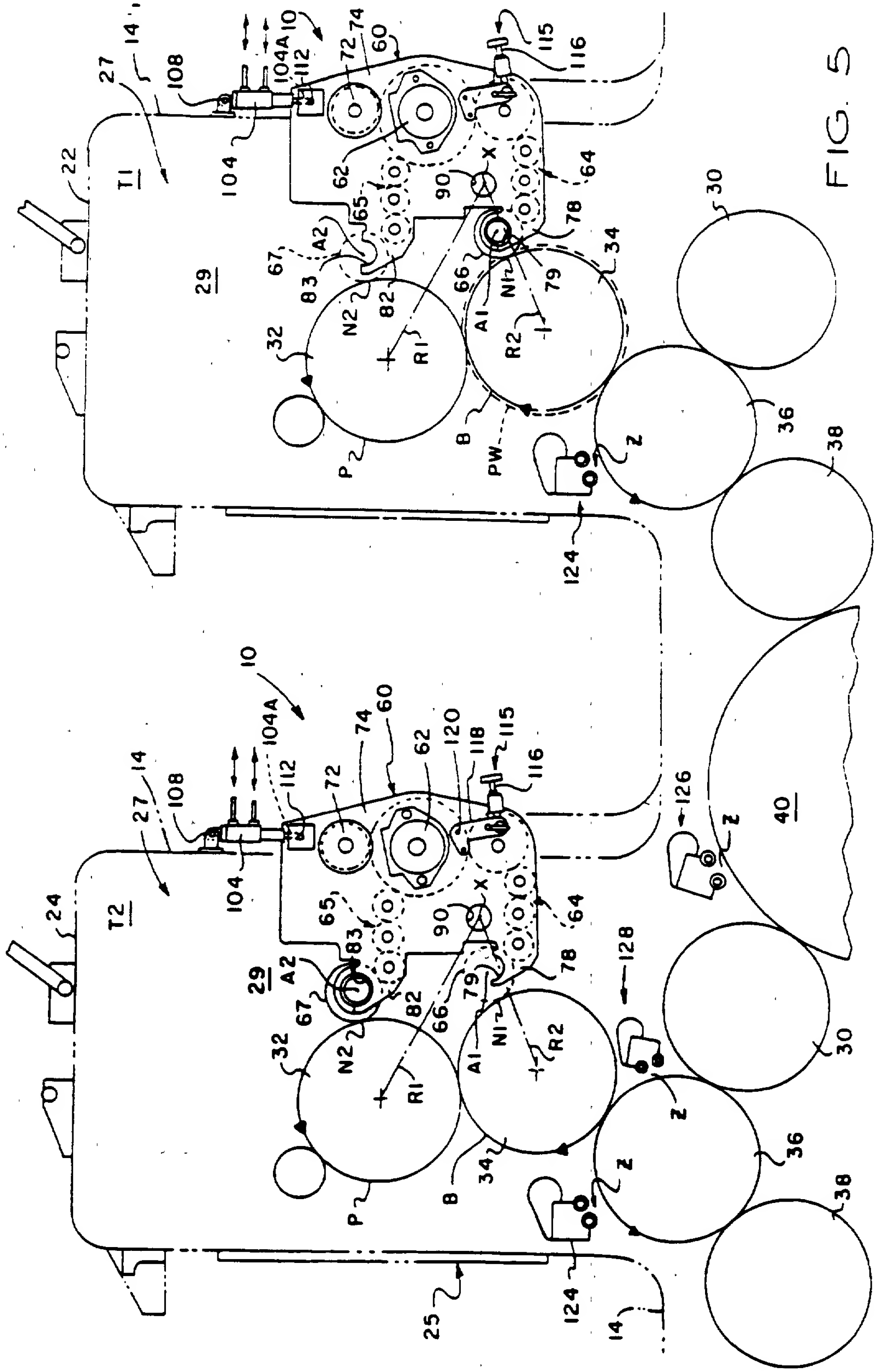

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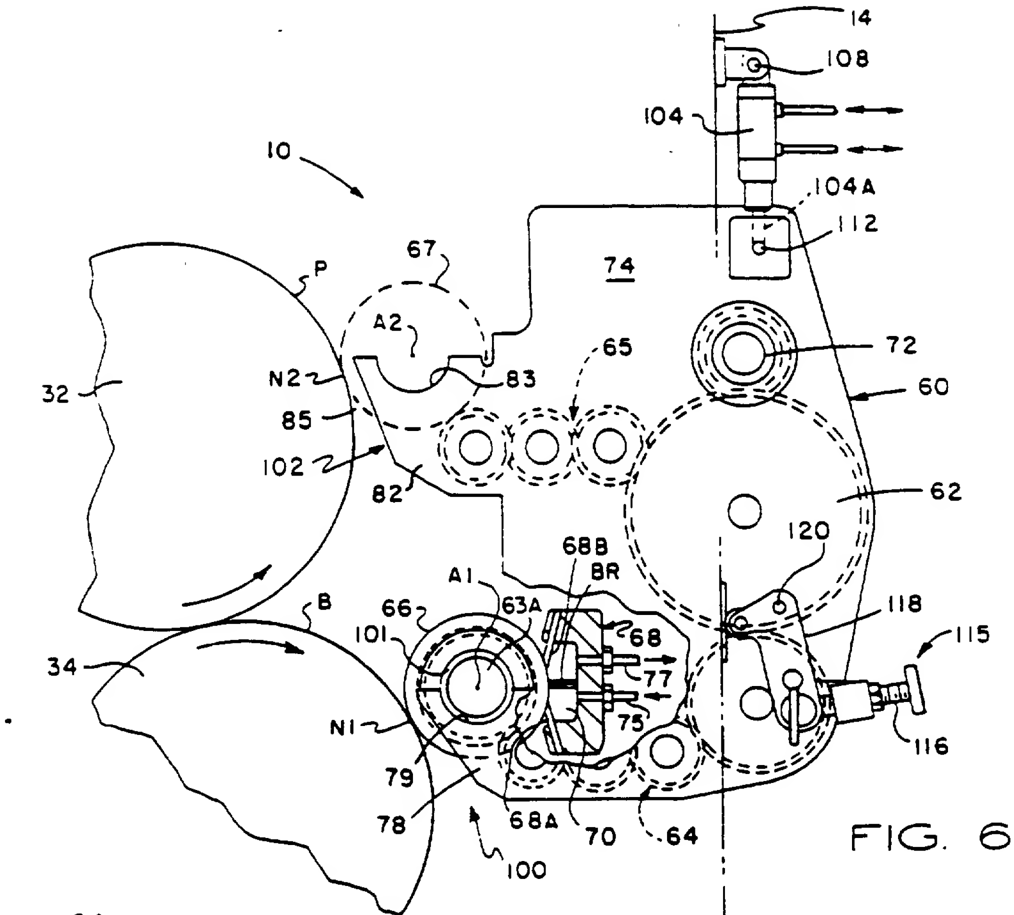

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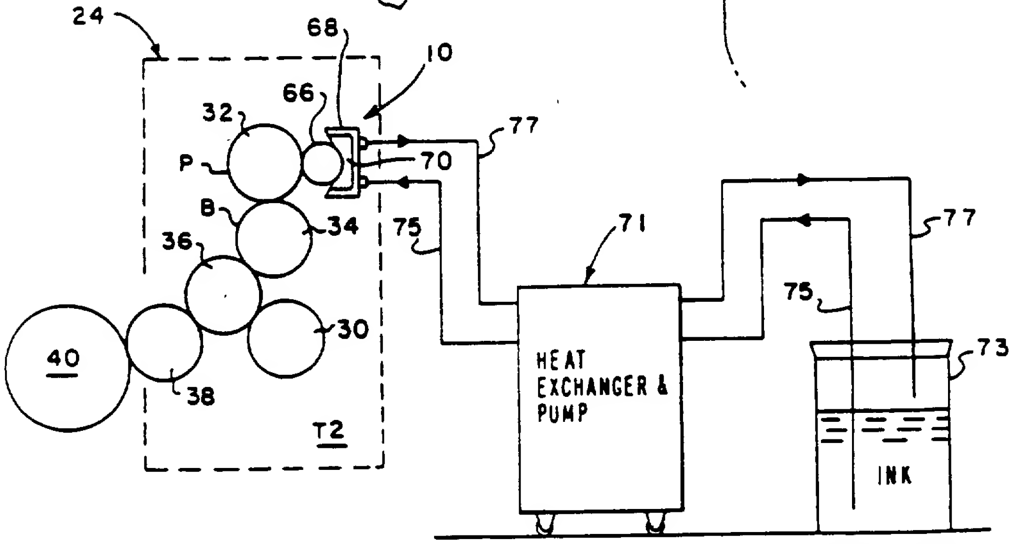

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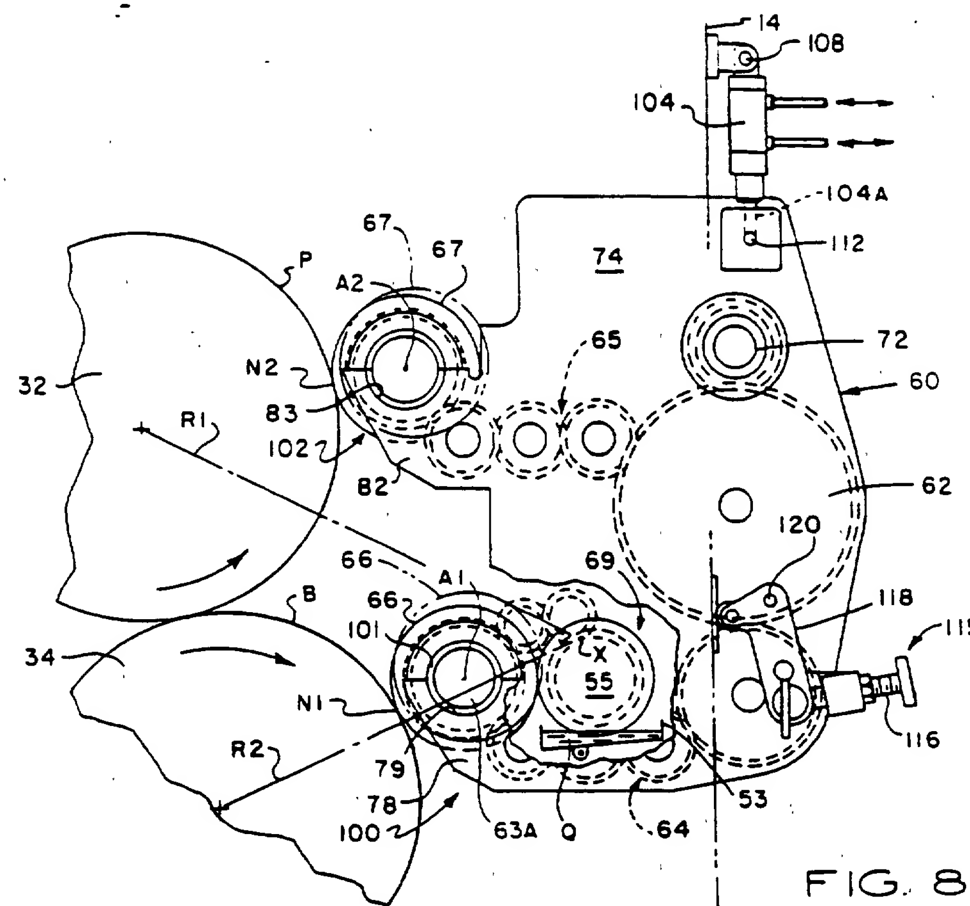
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104
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74
67
67
P
A2
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72
60
32
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62
120
66
A1
69
118
66
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63A
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64

FIG. 8

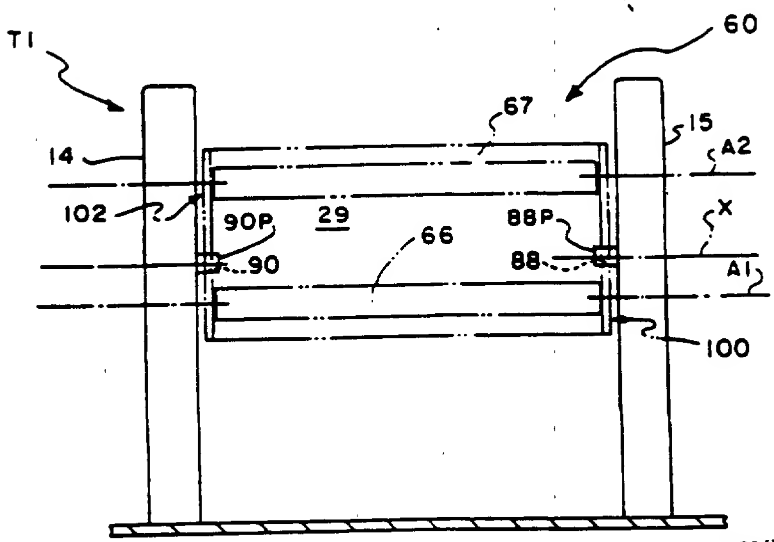
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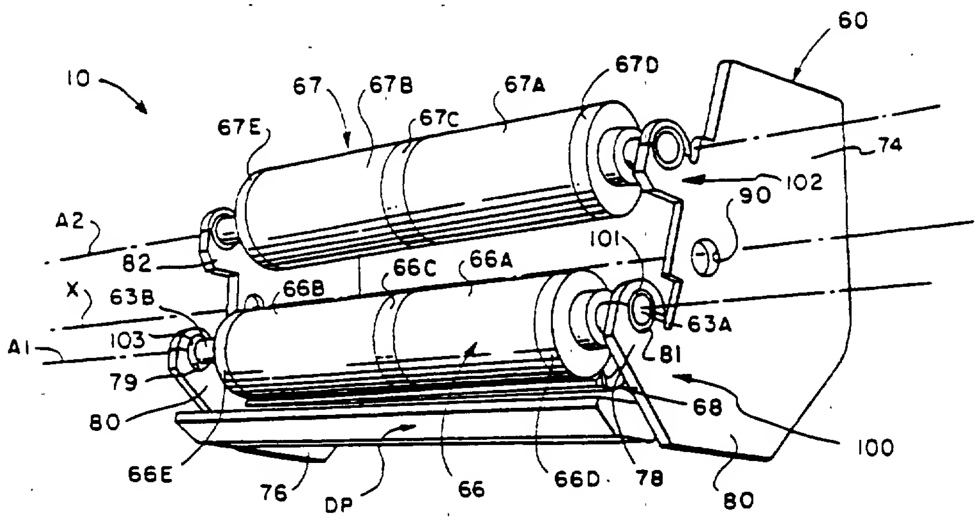
FIG. 9



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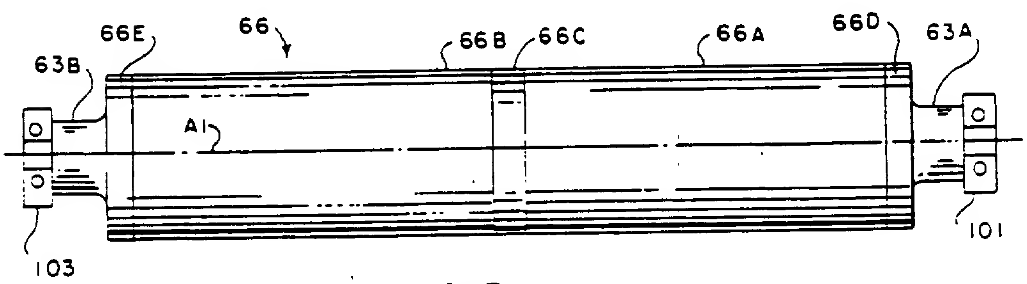

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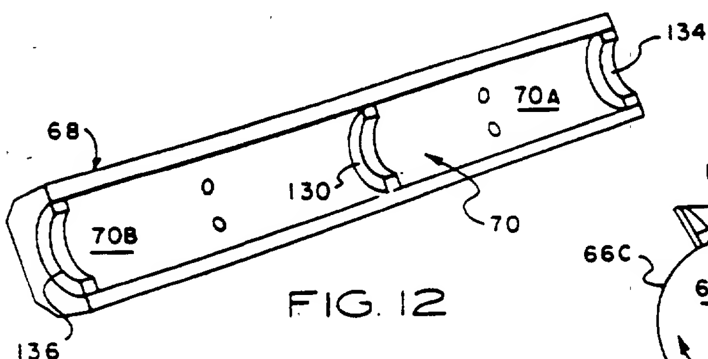

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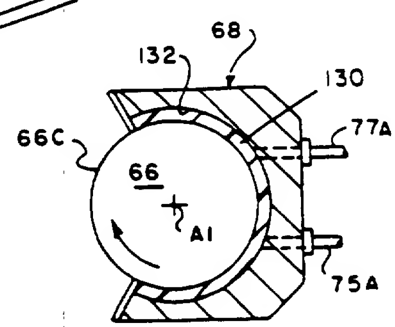

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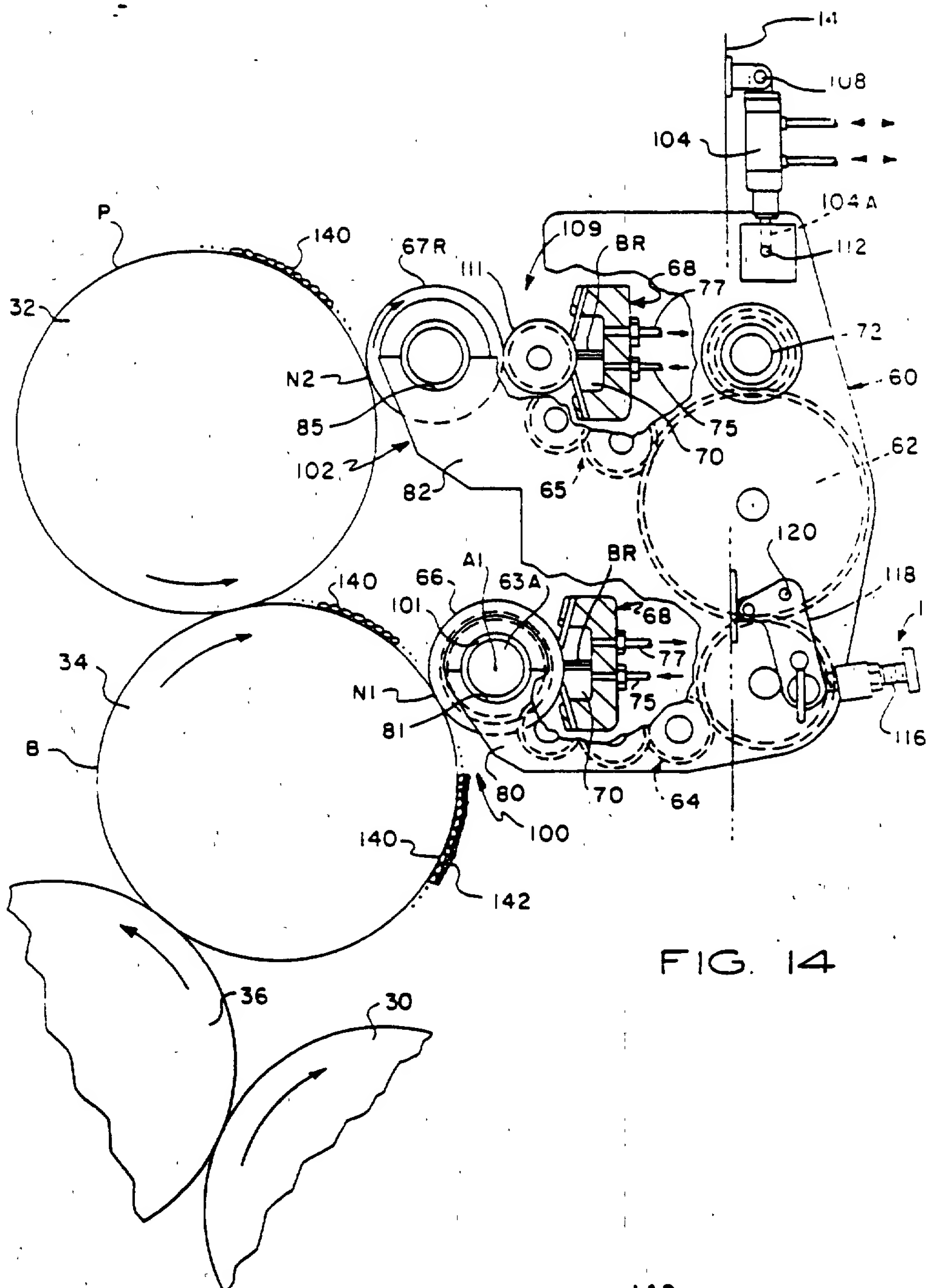

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104A
112
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140
67R
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BR
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111
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32
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N2
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70
62
102
82
65
120
118
115
116
140
66
A1
63A
BR
68
101
77
34
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B
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140
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36
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FIG. 14

140
142
S

FIG. 15

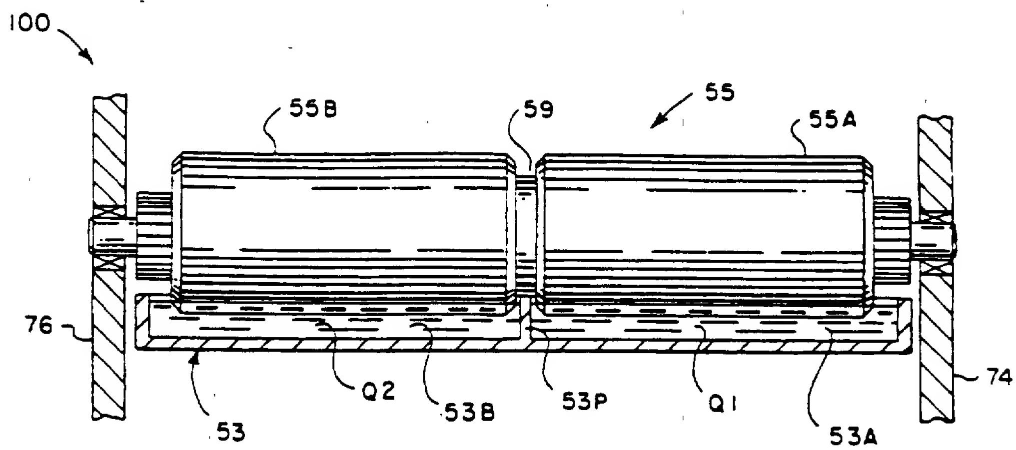
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FIG. 16

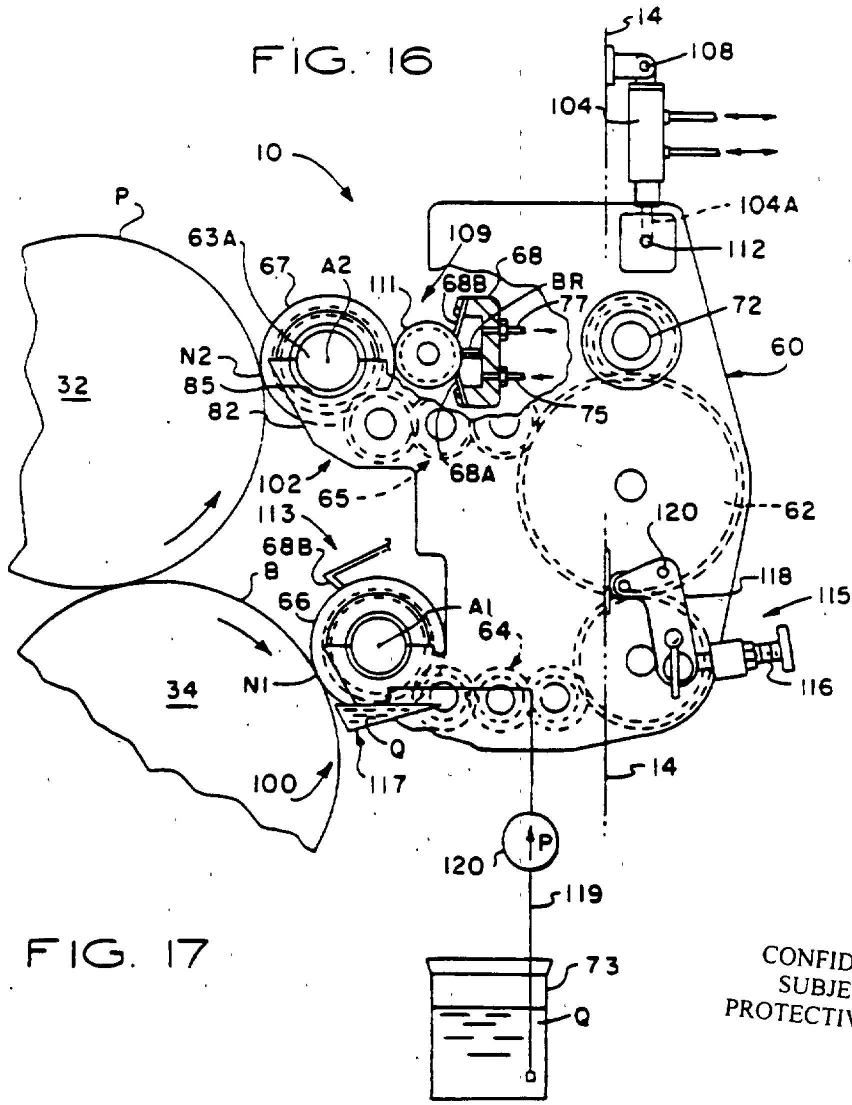
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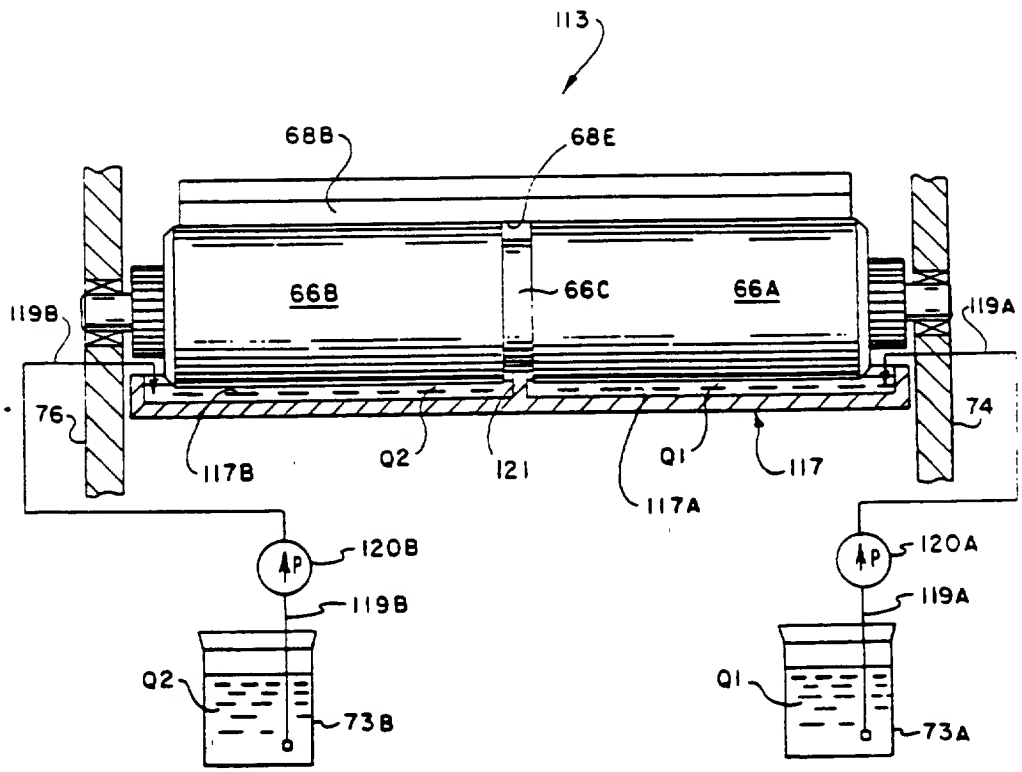
FIG. 17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Q2
73B
Q1
73A

FIG. 18

RETRACTABLE PRINTING/COATING UNIT OPERABLE ON THE PLATE AND BLANKET CYLINDERS

FIELD OF THE INVENTION

This invention relates generally to sheet-fed or web-fed, rotary offset lithographic printing presses, and more particularly, to a new and improved inking/coating apparatus for the in-line application of aqueous or flexographic printing inks, primer or protective/decorative coatings applied simultaneously to the plate and blanket of the first or any consecutive printing unit of any lithographic printing press.

BACKGROUND OF THE INVENTION

Conventional sheet-fed, rotary offset printing presses typically include one or more printing units through which individual sheets are fed and printed. After the last printing unit, freshly printed sheets are transferred by a delivery conveyor to the delivery end of the press where the freshly printed and/or coated sheets are collected and stacked uniformly. In a typical sheet-fed, rotary offset printing press such as the Heidelberg Speedmaster line of presses, the delivery conveyor includes a pair of endless chains carrying gripper bars with gripper fingers which grip and pull freshly printed sheets from the last impression cylinder and convey the sheets to the sheet delivery stacker.

Since the inks used with sheet fed rotary offset printing presses are typically wet and tacky, special precautions must be taken to prevent marking and smearing of the freshly printed or coated sheets as the sheets are transferred from one printing unit to another. The printed ink on the surface of the sheet dries relatively slowly and is easily smeared during subsequent transfer between printing units. Marking, smearing and smudging can be prevented by a vacuum assisted sheet transfer apparatus as described in the following U.S. Pat. Nos.: 5,113,255; 5,127,329; 5,205,217; 5,228,391; 5,243,909; and 5,419,254, all to Howard W. DeMoore, co-inventor, and manufactured and sold by Printing Research, Inc. of Dallas, Tex., U.S.A. under its trademark BACVAC™.

In some printing jobs, offsetting is prevented by applying a protective and/or decorative coating material over all or a portion of the freshly printed sheets. Some coatings are formed of a UV-curable or water-dispersed resin applied as a liquid solution over the freshly printed sheets to protect the ink from offsetting or set-off and improve the appearance of the freshly printed sheets. Such coatings are particularly desirable when decorative or protective finishes are applied in the printing of posters, record jackets, brochures, magazines, folding cartons and the like.

DESCRIPTION OF THE PRIOR ART

Various arrangements have been made for applying the coating as an in-line printing operation by using the last printing unit of the press as the coating application unit. For example, U.S. Pat. Nos. 4,270,483; 4,685,414; and 4,779,557 disclose coating apparatus which can be moved into position to permit the blanket cylinder of the last printing unit of a printing press to be used to apply a coating material over the freshly printed sheets. In U.S. Pat. No. 4,841,903 (Bird) there are disclosed coating apparatus which can be selectively moved between the plate cylinder or the blanket cylinder of the last printing unit of the press so the last printing unit can only be used for coating purposes. However, when coating apparatus of these types are being used, the last printing unit cannot be used to print ink to the sheets, but rather can only be used for the coating operation. Thus, while coating with this type of in-line coating apparatus, the printing press loses the capability of printing on the last printing unit as it is converted to a coating unit.

The coater of U.S. Pat. No 5,107,790 (Sliker et al) is retractable along an inclined rail for extending and retracting a coater head into engagement with a blanket on the blanket cylinder. Because of its size, the rail-retractable coater can only be installed between the last printing unit of the press and the delivery sheet stacker, and cannot be used for interunit coating. The coater of U.S. Pat. No. 4,615,293 (Jahn) provides two separate, independent coaters located on the dampener side of a converted printing unit for applying lacquer to a plate and to a rubber blanket. Consequently, although a plate and blanket are provided, the coating unit of Jahn's press is restricted to a dedicated coating operation only.

Proposals have been made for overcoming the loss of a printing unit when in-line coating is used, for example as set forth in U.S. Pat. No. 5,176,077 to Howard W DeMoore (co-inventor and assignee), which discloses a coating apparatus having an applicator roller positioned to apply the coating material to the freshly printed sheet while the sheet is still on the last impression cylinder of the press. This allows the last printing unit to print and coat simultaneously, so that no loss of printing unit capability results.

Some conventional coaters are rail-mounted and occupy a large amount of press space and reduce access to the press. Elaborate equipment is needed for retracting such coaters from the operative coating position to the inoperative position, which reduces access to the printing unit.

Accordingly, there is a need for an in-line inking/coating apparatus which does not result in the loss of a printing unit, does not extend the length of the press, and which can print and coat aqueous and flexographic inks and coating materials simultaneously onto the plate and blanket on any lithographic printing unit of any lithographic printing press, including the first printing unit.

OBJECTS OF THE INVENTION

Accordingly, a general object of the present invention is to provide improved inking/coating apparatus which is capable of selectively applying ink or coating material to a plate on a plate cylinder or ink or coating material to a plate or blanket on a blanket cylinder.

A specific object of the present invention is to provide improved inking/coating apparatus of the character described which is extendable into inking/coating engagement with either a plate on a plate cylinder or to a plate or blanket on a blanket cylinder.

A related object of the present invention is to provide improved inking/coating apparatus of the character described which is capable of being mounted on any lithographic printing unit of the press and does not interfere with operator access to the plate cylinder, blanket cylinder, or adjacent printing units.

Another object of the present invention is to provide improved inking/coating apparatus of the character described, which can be moved from an operative inking/coating engagement position adjacent to a plate cylinder or a blanket cylinder to a non-operative, retracted position.

Still another object of the present invention is to provide improved inking/coating apparatus of the character described, which can be used for applying aqueous, flexo-

graphic and ultra-violet curable inks and/or coatings in combination with lithographic, flexographic and waterless printing processes on any rotary offset printing press.

A related object of the present invention is to provide improved inking/coating apparatus of the character described, which is capable of applying aqueous or flexographic ink or coating material on one printing unit, for example the first printing unit, and drying the ink or coating material before it is printed or coated on the next printing unit so that it can be overprinted or overcoated immediately on the next printing unit with waterless, aqueous, flexographic or lithographic inks or coating materials.

Yet another object of the present invention is to provide improved inking/coating apparatus for use on a multiple color rotary offset printing press that can apply ink or coating material separately and/or simultaneously to the plate and/or blanket of a printing unit of the press from a single operative position, and from a single inking/coating apparatus.

A related object of the present invention is to provide improved inking/coating apparatus of the character described, in which virtually no printing unit adjustment or alteration is required when the inking/coating apparatus is converted from plate to blanket printing or coating and vice versa.

Another object of the present invention is to provide improved inking/coating apparatus that can be operably mounted in the dampener space of any lithographic printing unit for inking/coating engagement with either a plate on a plate cylinder or a plate or blanket on a blanket cylinder, and which does not interfere with operator movement or activities in the interunit space between printing units.

SUMMARY OF THE INVENTION

The foregoing objects are achieved by a retractable, in-line inking/coating apparatus which is mounted on the dampener side of any printing unit of a rotary offset press for movement between an operative (on-impression) inking/coating position and a retracted, disengaged (Off-impression) position. The inking/coating apparatus includes an applicator roller which is movable into and out of engagement with a plate on a plate cylinder or a blanket on a blanket cylinder. The inking/coating applicator head is pivotally coupled to a printing unit by pivot pins which are mounted on the press side frames in the traditional dampener space of the printing unit in parallel alignment with the plate cylinder and the blanket cylinder. This dampener space mounting arrangement allows the inking/coating unit to be installed between any adjacent printing units on the press.

In the preferred embodiment, the applicator head includes vertically spaced pairs of cradle members with one cradle pair being adapted for supporting an inking/coating applicator roller in alignment with a plate cylinder, and the other cradle pair supporting an inking/coating applicator roller in alignment with the blanket cylinder, respectively, when the applicator head is in the operative position. Because of the pivotal support provided by the pivot pins, the applicator head can be extended and retracted within the limited space available in the traditional dampener space, without restricting operator access to the printing unit cylinders and without causing a printing unit to lose its printing capability.

When the inking/coating apparatus is used in combination with a flexographic printing plate and aqueous or flexographic ink or coating material, the water component of the aqueous or flexographic ink or coating material on the

freshly printed or coated sheet is evaporated and dried by a high velocity, hot air interunit dryer and a high volume heat and moisture extractor assembly so that the freshly printed ink or coating material is dry before the sheet is printed or coated on the next printing unit. This quick drying process permits a base layer or film of ink, for example opaque white or metallic (gold, silver or other metallics) ink to be printed on the first printing unit, and then overprinted on the next printing unit without back-trapping or dot gain

The construction and operation of the present invention will be understood from the following detailed description taken in conjunction with the accompanying drawings which disclose, by way of example, the principles and advantages of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a sheet fed, rotary offset printing press having inking/coating apparatus embodying the present invention;

FIG. 2 is a simplified perspective view of the single head, dual cradle inking/coating apparatus of the present invention;

FIG. 3 is a schematic side elevational view of the printing press of FIG. 1 having single head, dual cradle inking/coating apparatus installed in the traditional dampener position of the first, second and last printing units;

FIG. 4 is a simplified side elevational view showing the single head, dual cradle inking/coating apparatus in the operative inking/coating position for simultaneously printing on the printing plate and blanket on the fourth printing unit;

FIG. 5 is a simplified side elevational view showing the single head, dual cradle inking/coating apparatus in the operative position for spot or overall inking or coating on the blanket of the first printing unit, and showing the dual cradle inking/coating apparatus in the operative position for spot or overall inking or coating on the printing plate of the second printing unit;

FIG. 6 is a simplified side elevational view of the single head, dual cradle inking/coating apparatus of FIG. 4 and FIG. 5, partially broken away, showing the single head, dual cradle inking/coating apparatus in the operative coating position and having a sealed doctor blade reservoir assembly for spot or overall coating on the blanket;

FIG. 7 is a schematic view showing a heat exchanger and pump assembly connected to the single head, dual cradle inking/coating apparatus for circulating temperature controlled ink or coating material to the inking/coating apparatus;

FIG. 8 is a side elevational view, partially broken away, and similar to FIG. 6 which illustrates an alternative coating head arrangement;

FIG. 9 is a simplified elevational view of a printing unit which illustrates pivotal coupling of the inking/coating apparatus on the printing unit side frame members.

FIG. 10 is a view similar to FIG. 2 in which a pair of split applicator rollers are mounted in the upper cradle and lower cradle, respectively;

FIG. 11 is a side elevational view of a split applicator roller.

FIG. 12 is a perspective view of a doctor blade reservoir which is centrally partitioned by a seal element.

FIG. 13 is a sectional view showing sealing engagement of the split applicator roller against the partition seal element of FIG. 12;

FIG. 14 is a view similar to FIG. 8 which illustrates an alternative inking/coating embodiment;

FIG. 15 is a simplified side elevational view of a substrate which has a bronzed-like finish which is applied by simultaneous operation of the dual applicator roller embodiment of FIG. 14.

FIG 16 is a side elevational view, partly in section, of a pan roller having separate transfer surfaces mounted on a split fountain pan;

FIG. 17 is a simplified side elevational view of the dual cradle inking/coating apparatus, partially broken away, which illustrates an alternative inking/coating head apparatus featuring a single doctor blade assembly, anilox applicator roller mounted on the lower cradle; and

FIG. 18 is a side elevational view, partly in section, of a single doctor blade anilox applicator roller assembly having separate transfer surfaces, and a split fountain pan having separate fountain compartments, with the separate fountain compartments being supplied with different inks or coating materials from separate off-press sources.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

As used herein, the term "processed" refers to printing and coating methods which can be applied to either side of a substrate, including the application of lithographic, waterless, UV-curable, aqueous and flexographic inks and/or coatings. The term "substrate" refers to sheet and web material. Also, as used herein, the term "waterless printing plate" refers to a printing plate having image areas and non-image areas which are oleophilic and oleophobic, respectively. "Waterless printing ink" refers to an oil-based ink which does not contain a significant aqueous component. "Flexographic plate" refers to a flexible printing plate having a relief surface which is wettable by flexographic ink or coating material. "Flexographic printing ink or coating material" refers to an ink or coating material having a base constituent of either water, solvent or UV-curable liquid. "UV-curable lithographic printing ink and coating material" refers to oil-based printing inks and coating materials that can be cured (dried) photomechanically by exposure to ultraviolet radiation, and that have a semi-paste or gel-like consistency. "Aqueous printing ink or coating material" refers to an ink or coating material that predominantly contains water as a solvent, diluent or vehicle. A "relief plate" refers to a printing plate having image areas which are raised relative to non-image areas which are recessed.

As shown in the exemplary drawings, the present invention is embodied in a new and improved in-line inking/coating apparatus, herein generally designated 10, for applying aqueous, flexographic or UV-curable inks or protective and/or decorative coatings to sheets or webs printed in a sheet-fed or web-fed, rotary offset printing press, herein generally designated 12. In this instance, as shown in FIG. 1, the inking/coating apparatus 10 is installed in a four unit rotary offset printing press 12, such as that manufactured by Heidelberger Druckmaschinen AG of Germany under its designation Heidelberg Speedmaster SM102 (40", 102 cm).

The press 12 includes a press frame 14 coupled at one end, herein the right end, to a sheet feeder 16 from which sheets, herein designated S, are individually and sequentially fed into the press, and at the opposite end, with a sheet delivery stacker 20 in which the freshly printed sheets are collected and stacked. Interposed between the sheet feeder 16 and the sheet delivery stacker 20 are four substantially identical sheet printing units 22, 24, 26 and 28 which can print four different colors onto the sheets as they are transferred through the press 12. The printing units are housed within printing towers T1, T2, T3 and T4 formed by side frame members 14, 15. Each printing tower has a delivery side 25 and a dampener side 27. A dampener space 29 is partially enclosed by the side frames on the dampener side of the printing unit.

As illustrated, the printing units 22, 24, 26 and 28 are substantially identical and of conventional design. The first printing unit 22 includes an in-feed transfer cylinder 30, a plate cylinder 32, a blanket cylinder 34 and an impression cylinder 36, all supported for rotation in parallel alignment between the press side frames 14, 15 which define printing unit towers T1, T2, T3 and T4. Each of the first three printing units 22, 24 and 26 have a transfer cylinder 38 disposed to transfer the freshly printed sheets from the adjacent impression cylinder and transfer the freshly printed sheets to the next printing unit via an intermediate transfer drum 40

The last printing unit 28 includes a delivery cylinder 42 mounted on a delivery shaft 43 The delivery cylinder 42 supports the freshly printed sheet 18 as it is transferred from the last impression cylinder 36 to a delivery conveyor system, generally designated 44, which transfers the freshly printed sheet to the sheet delivery stacker 20 To prevent smearing during transfer, a flexible covering is mounted on the delivery cylinder 42, as described and claimed in U.S. Pat. No 4,402,267 to Howard W. DeMoore, which is incorporated herein by reference. The flexible covering is manufactured and sold by Printing Research, Inc. of Dallas, Tex., U.S.A., under its trademark SUPER BLUE® Optionally, a vacuum-assisted sheet transfer assembly manufactured and sold by Printing Research, Inc. of Dallas, Tex., U.S.A., under its trademark BACVAC® can be substituted for the delivery transfer cylinder 42 and flexible covering

The delivery conveyor system 44 as shown in FIG. 3 is of conventional design and includes a pair of endless delivery gripper chains 46, only one of which is shown carrying at regular spaced locations along the chains, laterally disposed gripper bars having gripper fingers used to grip the leading edge of a freshly printed or coated sheet 18 after it leaves the nip between the impression cylinder 36 and delivery cylinder 42 of the last printing unit 28. As the leading edge is gripped by the gripper fingers, the delivery chains 46 pull the sheet away from the last impression cylinder 36 and convey the freshly printed or coated sheet to the sheet delivery stacker 20.

Prior to reaching the delivery sheet stacker, the freshly printed and/or coated sheets S pass under a delivery dryer 48 which includes a combination of infra-red thermal radiation, high velocity hot air flow and a high performance heat and moisture extractor for drying the ink and/or the protective/decorative coating. Preferably, the delivery dryer 48, including the high performance heat and moisture extractor is constructed as described in U.S. application Ser. No. 08/116,711, filed Sep. 3, 1993, entitled "Infra-Red Forced Air Dryer and Extractor" by Howard C. Secor, Ronald M. Rendleman and Paul D. Copenhaver, commonly assigned to the assignee of the present invention, Howard W. DeMoore, and licensed to Printing Research, Inc. of Dallas, Tex., U.S.A., which manufactures and markets the delivery dryer 48 under its trademark AIR BLANKET™.

In the exemplary embodiment shown in FIG. 3, the first printing unit 22 has a flexographic printing plate PF mounted on the plate cylinder, and therefore neither an inking roller train nor a dampening system is required A

flexographic printing plate PF is also mounted on the plate cylinder of the second printing unit 24. The form rollers of the inking roller train 52 shown mounted on the second printing unit 24 are retracted and locked off to prevent plate contact. Flexographic ink is supplied to the flexographic plate PF of the second printing unit 24 by the inking/coating apparatus 10.

A suitable flexographic printing plate PF is offered by E. I. du Pont de Nemours of Wilmington, Del., U.S.A., under its trademark CYREL®. Another source is BASF Aktiengesellschaft of Ludwigshafen, Germany, which offers a suitable flexographic printing plate under its trademark NYLOFLEX®.

The third printing unit 26 as illustrated in FIG. 3 and FIG. 4 is equipped for lithographic printing and includes an inking apparatus 50 having an inking roller train 52 arranged to transfer ink Q from an ink fountain 54 to a lithographic plate P mounted on the plate cylinder 32. This is accomplished by a fountain roller 56 and a ductor roller 57. The fountain roller 56 projects into the ink fountain 54, whereupon its surface picks up ink. The lithographic printing ink Q is transferred from the fountain roller 56 to the inking roller train 52 by the ductor roller 57. The inking roller train 52 supplies ink Q to the image areas of the lithographic printing plate P.

The lithographic printing ink Q is transferred from the lithographic printing plate P to an ink receptive blanket B which is mounted on the blanket cylinder 34. The inked image carried on the blanket B is transferred to a substrate S as the substrate is transferred through the nip between the blanket cylinder 34 and the impression cylinder 36.

The inking roller arrangement 52 illustrated in FIG. 3 and FIG. 4 is exemplary for use in combination with lithographic ink printing plates P. It is understood that a dampening system 58 having a dampening fluid reservoir DF is coupled to the inking roller train 52 (FIG. 4), but is not required for waterless or flexographic printing.

The plate cylinder 32 of printing unit 28 is equipped with a waterless printing plate PW. Waterless printing plates are also referred to as dry planographic printing plates and are disclosed in the following U.S. Pat. Nos.: 3,910,187; Reissue 30,670; U.S. Pat. No. 4,086,093; and U.S. Pat. No. 4,853,313. Suitable waterless printing plates can be obtained from Toray Industries, Inc. of Tokyo, Japan. A dampening system is not used for waterless printing, and waterless (oil-based) printing ink is used. The waterless printing plate PW has image areas and non-image areas which are oleophilic/hydrophilic and oleophobic/hydrophobic, respectively. The waterless printing plate PW is engraved or etched, with the image areas being recessed with respect to the non-image areas. The image area of the waterless printing plate PW is rolled-up with the flexographic or aqueous printing ink which is transferred by the applicator roller 66. Both aqueous and oil-based inks and coatings are repelled from the non-image areas, and are retained in the image areas. The printing ink or coating is then transferred from the image areas to an ink or coating receptive blanket B and is printed or coated onto a substrate S.

For some printing jobs, a flexographic plate PF or a waterless printing plate PW is mounted over a resilient packing such as the blanket B on the blanket cylinder 34, for example as indicated by phantom lines in printing unit 22 of FIG. 5. An advantage of this alternative embodiment is that the waterless plate PW or the flexographic plate PF are resiliently supported over the blanket cylinder by the underlying blanket B or other resilient packing. The radial deflection and give of the resilient blanket B provides uniform, positive engagement between the applicator roller 66 and a flexographic plate or waterless plate.

In that arrangement, a plate is not mounted on the plate cylinder 32; instead, a waterless plate PW is mounted on the blanket cylinder, and the inked image on the waterless printing plate is not offset but is instead transferred directly from the waterless printing plate PW to the substrate S. The water component of flexographic ink on the freshly printed sheet is evaporated by high velocity, hot air dryers and high volume heat and moisture extractors so that the freshly printed aqueous or flexographic ink is dried before the substrate is printed on the next printing unit.

Referring now to FIG. 2, FIG. 3 and FIG. 9, the inking/coating apparatus 10 is pivotally mounted on the side frames 14, 15 for rotation about an axis X. The inking/coating apparatus 10 includes a frame 60, a hydraulic motor 62, a lower gear train 64, an upper gear train 65, an applicator roller 66, a sealed doctor blade assembly 68 (FIG. 6), and a drip pan DP, all mounted on the frame 60. The external peripheral surface of the applicator roller 66 is wetted by contact with liquid coating material or ink contained in a reservoir 70.

The hydraulic motor 62 drives the applicator roller 66 synchronously with the plate cylinder 32 and the blanket cylinder 34 in response to an RPM control signal from the press drive (not illustrated) and a feedback signal developed by a tachometer 72. While a hydraulic drive motor is preferred, other drive means such as an electric drive motor or an equivalent can be used.

When using waterless printing plate systems, the temperature of the waterless printing ink and of the waterless printing plate must be closely controlled for good image reproduction. For example, for waterless offset printing with TORAY waterless printing plates PW, it is absolutely necessary to control the waterless printing plate surface and waterless ink temperature to a very narrow range, for example 24° C. (75° F.) to 27° C. (80° F.).

Referring to FIG. 7, the reservoir 70 is supplied with ink or coating which is temperature controlled by a heat exchanger 71. The temperature controlled ink or coating material is circulated by a positive displacement pump, for example a peristaltic pump, through the reservoir 70 and heat exchanger 71 from a source 73 through a supply conduit 75 and a return conduit 77. The heat exchanger 71 cools or heats the ink or coating material and maintains the ink or coating and the printing plate within the desired narrow temperature range.

According to one aspect of the present invention, aqueous/flexographic ink or coating material is supplied to the applicator roller 66, which transfers the aqueous/flexographic ink or coating material to the printing plate (FIG. 7), which may be a waterless printing plate or a flexographic printing plate. When the inking/coating apparatus is used for applying aqueous/flexographic ink or coating material to a waterless printing plate PW, the inking roller train 52 is not required, and is retracted away from the printing plate. Because the viscosity of aqueous/flexographic printing ink or coating material varies with temperature, it is necessary to heat or cool the aqueous/flexographic printing ink or coating material to compensate for ambient temperature variations to maintain the ink viscosity in a preferred operating range.

For example, the temperature of the printing press can vary from around 60° F. (15° C.) in the morning, to around 85° F. (29° C.) or more in the afternoon. The viscosity of

aqueous/flexographic printing ink or coating material can be marginally high when the ambient temperature of the press is near 60° F. (15° C.), and the viscosity can be marginally low when the ambient temperature of the press exceeds 85° F. (29° C.). Consequently, it is desirable to control the temperature of the aqueous/flexographic printing ink or coating material so that it will maintain the surface temperature of waterless printing plates within the specified temperature range. Moreover, the ink/coating material temperature should be controlled to maintain the tack of the aqueous/flexographic printing ink or coating material within a desired range when the ink or coating material is being used in connection with flexographic printing processes.

The applicator roller 66 is preferably an anilox fluid metering roller which transfers measured amounts of printing ink or coating material to a plate or blanket. The surface of an anilox roller is engraved with an array of closely spaced, shallow depressions referred as "cells". Ink or coating from the reservoir 70 flows into the cells as the anilox roller turns through the reservoir. The transfer surface of the anilox roller is "doctored" (wiped or scraped) by dual doctor blades 68A, 68B to remove excess ink or coating material. The ink or coating metered by the anilox roller is that contained within the cells. The dual doctor blades 68A, 68B also seal the supply reservoir 70.

The anilox applicator roller 66 is cylindrical and may be constructed in various diameters and lengths, containing cells of various sizes and shapes. The volumetric capacity of an anilox roller is determined by cell size, shape and number of cells per unit area. Depending upon the intended application, the cell pattern may be fine (many small cells per unit area) or coarse (fewer large cells per unit area).

By supplying the ink or coating material through the inking/coating apparatus 10, more ink or coating material can be applied to the sheet S as compared with the inking roller train of a lithographic printing unit. Moreover, color intensity is stronger and more brilliant because the aqueous or flexographic ink or coating material is applied at a much heavier film thickness or weight than can be applied by the lithographic process, and the aqueous or flexographic colors are not diluted by dampening solution.

Preferably, the sealed doctor blade assembly 68 is constructed as described in U.S. Pat. No. 5,176,077 to Howard W. DeMoore, co-inventor and assignee, which is incorporated herein by reference. An advantage of using a sealed reservoir is that fast drying ink or coating material can be used. Fast drying ink or coating material can be used in an open fountain 53 (see FIG. 8); however, open air exposure causes the water and solvents in the fast-drying ink or coating material to evaporate faster, thus causing the ink or coating material to dry prematurely and change viscosity. Moreover, an open fountain emits unwanted odors into the press room. When the sealed doctor blade assembly is utilized, the pump (FIG. 7) which circulates ink or coating material to the doctor blade head is preferably a peristaltic pump, which does not inject air into the feeder lines which supply the ink or coating reservoir 70 and helps to prevent the formation of air bubbles and foam within the ink or coating material.

An inking/coating apparatus 10 having an alternative applicator roller arrangement is illustrated in FIGS. 10–13. In this arrangement, the engraved metering surface of the anilox applicator rollers 66, 67 are partitioned by smooth seal surfaces 66C which separates a first engraved peripheral surface portion 66A from a second engraved peripheral surface portion 66B. Likewise, smooth seal surfaces 66D, 66E are formed on the opposite end portions of the applicator roller 66 for engaging end seals 134, 136 (FIG 12) of the doctor blade reservoir. The upper applicator roller 67 has engraved anilox metering surfaces 67A and 67B which are separated by a smooth seal band 67C.

Referring now to FIG. 12 and FIG. 13, the reservoir 70 of the doctor blade head 68 is partitioned by a curved seal element 130 to form two separate chambers 70A, 70B. The seal element 130 is secured to the doctor blade head within an annular groove 132. The seal element 130 is preferably made of polyurethane foam or other durable, resilient foam material. The seal element 130 is engaged by the seal band 66, thus forming a rotary seal which blocks the leakage of ink or coating material from one reservoir chamber into the other reservoir chamber. Moreover, the seal band provides an unprinted or uncoated area which separates the printed or coated areas from each other, which is needed for work and turn printing jobs or other printing jobs which print two or more separate images onto the same substrate.

Another advantage of the split applicator roller embodiment is that it enables two or more flexographic inks or coating materials to be printed simultaneously within the same lithographic printing unit. That is, the reservoir chambers 70A, 70B of the upper doctor blade assembly can be supplied with gold ink and silver ink, for example, while the reservoir chambers 70A, 70B of the lower doctor blade assembly can be supplied with inks of two additional colors, for example opaque white ink and blue ink. This permits the opaque white ink to be overprinted with the gold ink, and the blue ink to be overprinted with the silver ink on the same printing unit on any lithographic press.

Moreover, a catalyst can be used in the upper doctor blade reservoir and a reactive ink or coating material can be used in the lower doctor blade reservoir. This can provide various effects, for example improved chemical resistance and higher gloss levels.

The split applicator roller sections 67A, 67B in the upper cradle position can be used for applying two separate inks or coating materials simultaneously, for example flexographic, aqueous and ultra-violet curable inks or coating materials, to separate surface areas of the plate, while the lower applicator roller sections 66A, 66B can apply an initiator layer and a micro-encapsulated layer simultaneously to separate blanket surface areas. Optionally, the metering surface portions 66A, 66B can be provided with different cell metering capacities for providing different printing effects which are being printed simultaneously. For example, the screen line count on one half-section of an anilox applicator roller is preferably in the range of 200–600 lines per inch (79–236 lines per cm) for half-tone images, and the screen line count of the other half-section is preferably in the range of 100–300 lines per inch (39–118 lines per cm) for overall coverage, high weight applications such as opaque white. This split arrangement in combination with dual applicator rollers is particularly advantageous when used in connection with "work and turn" printing jobs.

Referring again to FIG. 8, instead of using the sealed doctor blade reservoir assembly 68 as shown in FIG. 6, an open fountain assembly 69 is provided by the fountain pan 53 which contains a volume of liquid ink Q or coating material. The liquid ink or coating material is transferred to the applicator roller 66 by a pan roller 55 which turns in contact with ink Q or coating material in the fountain pan. If a split applicator roller is used, the pan roller 55 is also split, and the pan is divided into two pan sections 53A, 53B by a separator plate 53P, as shown in FIG. 16.

In the alternative embodiment of FIG. 16, the pan roller 55 is divided into two pan roller sections 55A, 55B by a centrally located, annular groove 59. The separator plate 53P is received within and centrally aligned with the groove 59, but does not touch the adjoining roller faces. By this arrangement, two or more inks or coating materials Q1, Q2 are contained within the open pan sections 55A, 55B for transfer by the split pan roller sections 53A, 53B, respectively. This permits two or more flexographic inks or coating materials to be transferred to two separate image areas on the plate or on the blanket of the same printing unit. This arrangement is particularly advantageous for work and turn printing jobs or other printing jobs which print two or more separate images onto the same substrate.

The frame 60 of the inking/coating apparatus 10 includes side support members 74, 76 which support the applicator roller 66, gear train 64, gear train 65, doctor blade assembly 68 and the drive motor 62. The applicator roller 66 is mounted on stub shafts 63A, 63B which are supported at opposite ends on a lower cradle assembly 100 formed by a pair of side support members 78, 80 which have sockets 79, 81 and retainer caps 101, 103. The stub shafts are received in roller bearings 105, 107 which permit free rotation of the applicator roller 66 about its longitudinal axis A1 (axis A2 in the upper cradle). The retainer caps 101, 103 hold the stub shafts 63A, 63B and bearings 105, 107 in the sockets 79, 81 and hold the applicator roller 66 in parallel alignment with the pivot axis X.

The side support members 74, 76 also have an upper cradle assembly 102 formed by a pair of side support members 82, 84 which are vertically spaced with respect to the lower side plates 78, 80. Each cradle 100, 102 has a pair of sockets 79, 81 and 83, 85, respectively, for holding an applicator roller 66, 67 for spot coating or inking engagement with the printing plate P on the plate cylinder 32 (FIG. 4) or with a printing plate P or a blanket B on the blanket cylinder 34.

Preferably, the applicator roller 67 (FIG. 8, FIG. 9) the upper cradle (plate) position is an anilox roller having a resilient transfer surface. In the dual cradle arrangement as shown in FIG. 2, the press operator can quickly change from blanket inking/coating to plate inking/coating within minutes, since it is only necessary to release, remove and reposition or replace the applicator roller 66.

The capability to simultaneously print in the flexographic mode, the aqueous mode, the waterless mode, or the lithographic mode on different printing units of the same lithographic press and to print or coat from either the plate position or the blanket position on any one of the printing units is referred to herein as the LITHOFLEX™ printing process or system. LITHOFLEX™ is a trademark of Printing Research, Inc. of Dallas, Tex., U.S.A., exclusive licensee of the present invention.

Referring now to FIG. 14, an inking/coating apparatus 10 having an inking/coating assembly 109 of an alternative design is installed in the upper cradle position for applying ink and/or coating material to a plate P on the plate cylinder 32. According to this alternative embodiment, an applicator roller 67R having a resilient transfer surface is coupled to an anilox fluid metering roller which transfers measured amounts of printing ink or coating material to the plate P. The anilox roller 111 has a transfer surface constructed of metal, ceramic or composite material which is engraved with cells. The resilient applicator roller 67R is interposed in transfer engagement with the plate P and the metering surface of the anilox roller 111. The resilient transfer surface of the applicator roller 67R provides uniform, positive engagement with the plate.

Referring now to FIG. 17, an inking/coating apparatus 10 having an alternative inking/coating assembly 113 is installed in the lower cradle assembly 100 for applying flexographic or aqueous ink and/or coating material Q to a plate or blanket mounted on the blanket cylinder 34. Instead of using the sealed, dual doctor blade reservoir assembly 68 as shown in FIG. 6, an open, single doctor blade anilox roller assembly 113 is supplied with liquid ink Q or coating material contained in an open fountain pan 117. The liquid ink or coating material Q is transferred to the engraved transfer surface of the anilox roller 66 as it turns in the fountain pan 117. Excess ink or coating material Q is removed from the engraved transfer surface by a single doctor blade 68B. The liquid ink or coating material Q is pumped from an off-press source, for example the drum 73 shown in FIG. 17, through a supply conduit 119 into the fountain pan 117 by a pump 120.

For overall inking or coating jobs, the metering transfer surface of the anilox roller 66 extends over its entire peripheral surface. However, for certain printing jobs which print two or more separate images onto the same substrate, for example work and turn printing jobs, the metering transfer surface of the anilox applicator roller 66 is partitioned by a centrally located, annular undercut groove 66C which separates first and second metering transfer surfaces 66A, 66B as shown in FIG. 11 and FIG. 18.

The single doctor blade 68B has an edge 68E which wipes simultaneously against the split metering transfer surfaces 66A, 66B. In this single blade, split anilox roller embodiment 113, it is necessary to provide dual supply sources, for example drums 73A, 73B, dual supply lines 119A, 119B, and dual pumps 120A, 120B. Moreover, the fountain pan 117 is also split, and the pan 117 is divided into two pan sections 117A, 117B by a separator plate 121, as shown in FIG 18. The separator plate 121 is centrally aligned with the undercut groove 66C, but does not touch the adjoining roller faces.

Although the single blade, split anilox applicator roller assembly 113 is shown mounted in the lower cradle position (FIG. 17), it should be understood that the single blade, split anilox applicator roller assembly 113 can be mounted and used in the upper cradle position, as well.

According to another aspect of the present invention, the inking/coating apparatus 10 is pivotally coupled on horizontal pivot pins 88P, 90P which allows the single head, dual cradle inking/coating apparatus 10 to be mounted on any lithographic printing unit. Referring to FIG. 9, the horizontal pivot pins 88P, 90P are mounted within the traditional dampener space 29 of the printing unit and are secured to the press side frames 14, 15, respectively. Preferably, the pivot support pins 88P, 90P are secured to the press side frames by a threaded fastener. The pivot support pins are received within circular openings 88, 90 which intersect the side support members 74, 76 of the inking/coating apparatus 10. The horizontal support pins 88P, 90P are disposed in parallel alignment with rotational axis X and with the plate cylinder and blanket cylinder, and are in longitudinal alignment with each other.

Preferably, the pivot pins 88P, 90P are located in the dampener space 29 so that the rotational axes A1, A2 of the applicator rollers 66, 67 are elevated with respect to the nip contact points N1, N2. By that arrangement, the transfer point between the applicator roller 66 and a blanket on the blanket cylinder 34 (as shown in FIG. 8) and the transfer

point between the applicator roller 66 and a plate on the plate cylinder 32 (as shown in FIG. 5) are above the radius lines R1, R2 of the plate cylinder and the blanket cylinder, respectively. This permits the inking/coating apparatus 10 to move clockwise to retract the applicator roller 66 to an off-impression position relative to the blanket cylinder in response to a single extension stroke of the power actuator arms 104A, 106A. Similarly, the applicator roller 66 is moved counterclockwise to the on-impression operative position as shown in FIGS. 4, 5, 6 and 8 by a single retraction stroke of the actuator arms 104A, 106A, respectively.

Preferably, the pivot pins are made of steel and the side support members are made of aluminum, with the steel pivot pins and the aluminum collar portion bordering the circular openings 88, 90 forming a low friction journal. By this arrangement, the inking/coating apparatus 10 is freely rotatable clockwise and counterclockwise with respect to the pivot pins 88P, 90P. Typically, the arc length of rotation is approximately 60 mils (about 1.5 mm). Consequently, the inking/coating apparatus 10 is almost totally enclosed within the dampener space 29 of the printing unit in the on-impression position and in the off-impression position.

The cradle assemblies 100 and 102 position the applicator roller 66 in inking/coating alignment with the plate cylinder or blanket cylinder, respectively, when the inking/coating apparatus 10 is extended to the operative (on-impression) position. Moreover, because the inking/coating apparatus 10 is installed within the dampener space 29, it is capable of freely rotating through a small arc while extending and retracting without being obstructed by the press side frames or other parts of the printing press. This makes it possible to install the inking/coating apparatus 10 on any lithographic printing unit. Moreover, because of its internal mounting position within the dampener space 29, the projection of the inking/coating apparatus 10 into the space between printing units is minimal. This assures unrestricted operator access to the printing unit when the applicator head is in the operative (on-impression) and retracted (off-impression) positions.

As shown in FIG. 4 and FIG. 5, movement of the inking/coating apparatus 10 is counterclockwise from the retracted (off-impression) position to the operative (on-impression) position.

Although the dampener side installation is preferred, the inking/coating apparatus 10 can be adapted for operation on the delivery side of the printing unit, with the inking/coating apparatus being movable from a retracted (off-impression) position to an on-impression position for engagement of the applicator roller with either a plate on the plate cylinder or a blanket on the blanket cylinder on the delivery side 25 of the printing unit.

Movement of the inking/coating apparatus 10 to the operative (on-impression) position is produced by power actuators, preferably double acting pneumatic cylinders 104, 106 which have extendable/retractable power transfer arms 104A, 106A, respectively. The first pneumatic cylinder 104 is pivotally coupled to the press frame 14 by a pivot pin 108, and the second pneumatic cylinder 106 is pivotally coupled to the press frame 15 by a pivot pin 110. In response to selective actuation of the pneumatic cylinders 104, 106, the power transfer arms 104A, 106A are extended or retracted. The power transfer arm 104A is pivotally coupled to the side support member 74 by a pivot pin 112. Likewise, the power transfer arm 106A is pivotally coupled to the side support member 76 by a pivot pin 114.

As the power arms extend, the inking/coating apparatus 10 is rotated clockwise on the pivot pins 88P, 90P, thus moving the applicator roller 66 to the off-impression position. As the power arms retract, the inking/coater apparatus 60 is rotated counterclockwise on the pivot pins 88P, 90P, thus moving the applicator roller 66 to the on-impression position. The torque applied by the pneumatic actuators is transmitted to the inking/coating apparatus 10 through the pivot pin 112 and pivot pin 114.

Fine adjustment of the on-impression position of the applicator roller relative to the plate cylinder or the blanket cylinder, and of the pressure of roller engagement, is provided by an adjustable stop assembly 115. The adjustable stop assembly 115 has a threaded bolt 116 which is engagable with a bell crank 118. The bell crank 118 is pivotally coupled to the side support member 74 on a pin 120. One end of the bell crank 118 is engagable by the threaded bolt 116, and a cam roller 122 is mounted for rotation on its opposite end. The striking point of engagement is adjusted by rotation of the bolt 116 so that the applicator roller 66 is properly positioned for inking/coating engagement with the plate P or blanket B and provides the desired amount of inking/coating pressure when the inking/coating assembly 60 is moved to the operative position.

This arrangement permits the in-line inking/coating apparatus to operate effectively without encroaching in the interunit space between any adjacent printing units, and without blocking or obstructing access to the cylinders of the printing units when the inking/coating apparatus is in the extended (off-impression) position or retracted (on-impression) position. Moreover, when the in-line inking/coating apparatus is in the retracted position, the doctor blade reservoir and coating circulation lines can be drained and flushed automatically while the printing press is running as well as when the press has been stopped for change-over from one job to another or from one type of ink or coating to another.

Substrates which are printed or coated with aqueous flexographic printing inks require high velocity hot air for drying. When printing a flexographic ink such as opaque white or metallic gold, it is always necessary to dry the printed substrates between printing units before overprinting them. According to the present invention, the water component on the surface of the freshly printed or coated substrate S is evaporated and dried by high velocity, hot air interunit dryer and high volume heat and moisture extractor units 124, 126 and 128, as shown in FIG. 2, FIG. 4 and FIG 5. The dryer/extractor units 124, 126 and 128 are oriented to direct high velocity heated air onto the freshly printed/coated substrates as they are transferred by the impression cylinder 36 and the intermediate transfer drum 40 of one printing unit and to another transfer cylinder 30 and to the impression cylinder 36 of the next printing unit. By that arrangement, the freshly printed flexographic ink or coating material is dried before the substrate S is overprinted by the next printing unit.

The high velocity, hot air dryer and high performance heat and moisture extractor units 124, 126 and 128 utilize high velocity air jets which scrub and break-up the moist air layer which clings to the surface of each freshly printed or coated sheet or web. Within each dryer, high velocity air is heated as it flows across a resistance heating element within an air delivery baffle tube. High velocity jets of hot air are discharged through multiple airflow apertures into an exposure zone Z (FIG. 4 and FIG. 5) and onto the freshly printed/coated sheet S as it is transferred by the impression cylinder 36 and transfer drum 40, respectively.

Each dryer assembly includes a pair of air delivery dryer heads 124D, 126D and 128D which are arranged in spaced,

side-by-side relationship. The high velocity, hot air dryer and high performance heat and moisture extractor units 124, 126 and 128 are preferably constructed as disclosed in co-pending U.S. patent application Ser. No. 08/132,584, filed Oct. 6, 1993, entitled "High Velocity Hot Air Dryer", to Howard W DeMoore, co-inventor and assignee of the present invention, and which is incorporated herein by reference, and which is marketed by Printing Research, Inc. of Dallas, Tex., U.S.A., under its trademark SUPER BLUE HV™.

The hot moisture-laden air displaced from the surface of each printed or coated sheet is extracted from the dryer exposure zone Z and exhausted from the printing unit by the high volume extractors 124, 126 and 128. Each extractor head includes an extractor manifold 124E, 126E and 128E coupled to the dryer heads 124D, 126D and 128D and draws the moisture, volatiles, odors and hot air through a longitudinal air gap G between the dryer heads. Best results are obtained when extraction is performed simultaneously with drying. Preferably, an extractor is closely coupled to the exposure zone Z at each dryer location as shown in FIG. 4. Extractor heads 124E, 126E and 128E are mounted on the dryer heads 124D, 126D and 128D, respectively, with the longitudinal extractor air gap G facing directly into the exposure zone Z. According to this arrangement, each printed or coated sheet is dried before it is printed on the next printing unit.

The aqueous water-based inks used in flexographic printing evaporate at a relatively moderate temperature provided by the interunit high velocity hot air dryers/extractors 124, 126 and 128. Sharpness and print quality are substantially improved since the flexographic ink or coating material is dried before it is overprinted on the next printing unit. Since the freshly printed flexographic ink is dry, dot gain is substantially reduced and back-trapping on the blanket of the next printing unit is virtually eliminated. This interunit drying/extracting arrangement makes it possible to print flexographic inks such as metallic ink and opaque white ink on the first printing unit, and then dry-trap and overprint on the second and subsequent printing units.

Moreover, this arrangement permits the first printing unit 22 to be used as a coater in which a flexographic, aqueous or UV-curable coating material is applied to the lowest grade substrate such as recycled paper, cardboard, plastic and the like, to trap and seal-in lint, dust, spray powder and other debris and provide a smoother, more durable printing surface which can be overprinted on the next printing unit.

A first down (primer) aqueous coating layer seals-in the surface of a low grade, rough substrate, for example, recycled paper or plastic, and improves overprinted dot definition and provides better ink lay-down while preventing strike-through and show-through. A flexographic UV-curable coating material can then be applied downstream over the primer coating, thus producing higher coating gloss.

Preferably, the applicator roller 66 is constructed of composite carbon fiber material, metal or ceramic coated metal when it is used for applying ink or coating material to the blanket B or other resilient material on the blanket cylinder 34. When the applicator roller 66 is applied to the plate, it is preferably constructed as an anilox roller having a resilient, compressible transfer surface. Suitable resilient roller surface materials include Buna N synthetic rubber and EPDM (terpolymer elastomer).

It has been demonstrated in prototype testing that the inking/coating apparatus 10 can apply a wide range of ink and coating types, including fluorescent (Day Glo), pearl-

escent, metallics (gold, silver and other metals), glitter, scratch and sniff (micro-encapsulated fragrance), scratch and reveal, luminous, pressure-sensitive adhesives and the like, as well as UV-curable and aqueous coatings

With the dampener assembly removed from the printing unit, the inking/coating apparatus 10 can easily be installed in the dampener space for selectively applying flexographic inks and/or coatings to a flexographic or waterless printing plate or to the blanket. Moreover, overprinting of the flexographic inks and coatings can be performed on the next printing unit since the flexographic inks and/or coatings are dried by the high velocity, hot air interunit dryer and high volume heat and moisture extractor assembly of the present invention.

The flexographic inks and coatings as used in the present invention contain colored pigments and/or soluble dyes, binders which fix the pigments onto the surface of the substrate, waxes, defoamers, thickeners and solvents. Aqueous printing inks predominantly contain water as a diluent and/or vehicle. The thickeners which are preferred include algonates, starch, cellulose and its derivatives, for example cellulose esters or cellulose ethers and the like. Coloring agents including organic as well as inorganic pigments may be derived from dyes which are insoluble in water and solvents. Suitable binders include acrylates and/or polyvinylchloride.

When metallic inks are printed, the cells of the anilox roller must be appropriately sized to prevent the metal particles from getting stuck within the cells. For example, for metallic gold ink, the anilox roller should have a screen line count in the range of 175–300 lines per inch (68–118 lines per cm). Preferably, in order to keep the anilox roller cells clear, the doctor blade assembly 68 is equipped with a bristle brush BR (FIG. 14) as set forth in U.S. Pat. No 5,425,809 to Steven M. Person, assigned to Howard W DeMoore, and licensed to Printing Research, Inc. of Dallas, Tex., U.S.A., which is incorporated herein by reference

The inking/coating apparatus 10 can also apply UV-curable inks and coatings. If UV-curable inks and coatings are utilized, ultra-violet dryers/extractors are installed adjacent to the high velocity hot air dryer/extractor units 124, 126 and 128, respectively.

It will be appreciated that the LITHOFLEX™ printing process described herein makes it possible to selectively operate a printing unit of a press in the lithographic printing mode while simultaneously operating another printing unit of the same press in either the flexographic printing mode or in the waterless printing mode, while also providing the capability to print or coat, separately or simultaneously, from either the plate position or the blanket position. The dual cradle support arrangement of the present invention makes it possible to quickly change over from inking/coating on the blanket cylinder position to inking/coating on the plate cylinder position with minimum press down-time, since it is only necessary to remove and reposition or replace the applicator roller 66 while the inking/coating apparatus 10 is in the retracted position. It is only necessary to remove four cap screws, lift the applicator roller 66 from the cradle, and reposition it in the other cradle. All of this can be accomplished in a few minutes, without removing the inking/coating apparatus 10 from the press.

It is possible to spot coat or overall coat from the plate position or from the blanket position with flexographic inks or coatings on one printing unit and then spot coat or overall coat with UV-curable inks or coatings from the plate position or from the blanket position on another printing unit

during the same press run. Moreover, the press operator can spot or overall coat from the plate for one job, and then spot and/or overall coat from the blanket on the next job.

The positioning of the applicator roller relative to the plate or blanket is repeatable to a predetermined preset operative position. Consequently, only minor printing unit modifications or alterations may be required for the LITHOFLEX™ process. Although automatic extension and retraction have been described in connection with the exemplary embodiment, extension to the operative (on-impression) position and retraction to a non-operative (off-impression) position can be carried out manually, if desired. In the manual embodiment, it is necessary to latch the inking/coating apparatus 10 to the press side frames 14, 15 in the operative (on-impression) position, and to mechanically prop the inking/coating apparatus in the off-impression (retracted) position.

Referring again to FIG. 8, an applicator roller 66 is mounted on the lower cradle assembly 100 by side support members 78, 80, and a second applicator roller 66 is mounted on the upper cradle assembly 102 by side support members 82, 84. According to this arrangement, the inking/coating apparatus 10 can apply printing ink and/or coating material to a plate on the plate cylinder, while simultaneously applying printing ink and/or coating material to a plate or a blanket on the blanket cylinder of the same printing unit. When the same color ink is used by the upper and lower applicator rollers from the plate position and from the blanket position simultaneously on the same printing unit, a "double bump" or double inking films or coating layers are applied to the substrate S during a single pass of the substrate through the printing unit. The tack of the two inks or coating materials must be compatible for good transfer during the double bump. Moreover, the inking/coating apparatus 10 can be used for supplying ink or coating material to the blanket cylinder of a rotary offset web press, or to the blanket of a dedicated coating unit.

According to conventional bronzing techniques, a metallic (bronze) powder is applied off-line to previously printed substrate which produces a grainy, textured finish or appearance. The on-line application of bronze material by conventional flexographic or lithographic printing will only produce a smooth, continuous appearance. However, a grainy, textured finish is preferred for highest quality printing which, prior to the present invention, could only be produced by off-line methods.

Referring now to FIG. 14 and FIG. 15, metallic ink or coating material is applied on-line to the substrate S by simultaneous operation of the upper and lower applicator rollers 67R, 66 to produce an uneven surface finish having a bronze-like textured or grainy appearance. According to the simulated bronzing method of the present invention, the flexographic bronze ink is applied simultaneously to the plate and to the blanket by the dual cradle inking/coating apparatus 10 as shown in FIG. 14. A resilient applicator roller 67R is mounted in the upper cradle 102, and an anilox applicator roller 66 is mounted on the lower cradle 100. The rollers are supplied from separate doctor blade reservoirs 70. The doctor blade reservoir 70 in the upper cradle position supplies bronze ink or coating material having relatively coarse, metallic particles 140 dispersed in aqueous or flexographic ink. The coarse particle ink or coating material is applied to the plate P by the resilient applicator roller 67R in the upper cradle position 102. At the same time, flexographic and/or bronze ink or coating material having relatively fine, metallic particles 142 is transferred to the blanket B by the anilox roller 66 which is mounted on the lower cradle 100.

The metering surfaces of the upper and lower applicator rollers have different cell sizes and volumetric capacities which accommodate the coarse and fine metallic particles. For example, the anilox roller 111 mounted in the upper cradle position 102 which transfers the coarse metallic particles 140 preferably has a screen line count in the range of 100–300 lines per inch (39–118 lines per cm), and the metering surface of the anilox roller 66 mounted on the lower cradle 100 which transfers the relatively fine metallic particles 142 preferably has a screen line count in the range of 200–600 lines per inch (79–236 lines per cm).

After transfer from the plate to the blanket, the fine metallic particles 142 form a layer over the coarse metallic particles 140. As both bronze layers are offset onto the substrate S, the layer of fine metallic particles 142 is printed onto the substrate S with the top layer of coarse metallic particles 140 providing a textured, grainy appearance. The fine metallic particles 142 cover the substrate which would otherwise be visible in the gaps between the coarse metallic particles 140. The combination of the coarse particle layer over the fine particle layer thus provides a textured, bronzed-like finish and appearance.

Particulate materials other than metal can be used for producing a textured finish. For example, coarse and fine particles of metallized plastic (glitter), mica particles (pearlescent) and the like, can be substituted for the metallic particles for producing unlimited surface variations, appearances and effects. All of the particulate material, including the metallic particles, are preferably in solid, flat platelet form, and have a size dimension suitable for application by an anilox applicator roller. Other particulate or granular material, for example stone grit having irregular form and size, can be used to good advantage.

Solid metal particles in platelet form, which are good reflectors of light, are preferred for producing the bronzed-like appearance and effect. However, various textured finishes, which could have light-reflective properties, can be produced by using granular materials such as stone grit. Most commonly used metals include copper, zinc and aluminum. Other ductile metals can be used, if desired. Moreover, the coarse and fine particles need not be made of the same particulate material. Various effects and textured appearances can be produced by utilizing diverse particulate materials for the coarse particles and the fine particles, respectively. Further, either fine or coarse particle ink or coating material can be printed from the upper cradle position, and either fine or coarse particle ink or coating material can be printed from the lower cradle position, depending on the special or surface finish that is desired.

It will be appreciated that the last printing unit 28 can be configured for additional inking/coating capabilities which include lithographic, waterless, aqueous and flexographic processes. Various substrate surface effects (for example double bump or triple bump inking/coating or bronzing) can be performed on the last printing unit. For triple bump inking/coating, the last printing unit 28 is equipped with an auxiliary in-line inking or coating apparatus 97 as shown in FIG. 3 and FIG. 4. The in-line inking or coating apparatus 97 allows the application of yet another film of ink or a protective or decorative layer of coating material over any freshly printed or coated surface effects or special treatments, thereby producing a triple bump. The triple bump is achieved by applying a third film of ink or layer of coating material over the freshly printed or coated double bump simultaneously while the substrate is on the impression cylinder of the last printing unit.

When the in-line inking/coating apparatus 97 is installed, it is necessary to remove the SUPER BLUE® flexible

covering from the delivery cylinder 42, and it is also necessary to modify or convert the delivery cylinder 42 for inking/coating service by mounting a plate or blanket B on the delivery cylinder 42, as shown in FIG. 3 and FIG. 4. Packing material is placed under the plate or blanket B, thereby packing the plate or blanket B at the correct packed-to-print radial clearance so that ink or coating material will be printed or coated onto the freshly printed substrate S as it transfers through the nip between the plate or blanket B on the converted delivery cylinder 42 and the last impression cylinder 36. According to this arrangement, a freshly printed or coated substrate is overprinted or overcoated with a third film or layer of ink or coating material simultaneously while a second film or layer of ink or coating material is being over-printed or over-coated on the last impression cylinder 36.

The auxiliary inking/coating apparatus 97 and the converted or modified delivery cylinder 42 are mounted on the delivery drive shaft 43. The inking/coating apparatus 97 includes an applicator roller, preferably an anilox applicator roller 97A, for supplying ink or coating material to a plate or blanket B on the modified or converted delivery cylinder 42. The in-line inking/coating apparatus 97 and the modified or converted delivery cylinder 42 are preferably constructed as described in U.S. Pat. No. 5,176,077 to Howard W. DeMoore (co-inventor and assignee), which is hereby incorporated by reference. The in-line inking/coating apparatus 97 is manufactured and sold by Printing Research, Inc. of Dallas, Tex., U.S.A., under its trademark SUPER BLUE EZ COATER™.

After the delivery cylinder 42 has been modified or converted for inking/coating service, and because of the reduced nip clearance imposed by the plate or blanket B, the modified delivery cylinder 42 can no longer perform its original function of guiding and transferring the freshly printed or coated substrate. Instead, the modified or converted delivery cylinder 42 functions as a part of the inking/coating apparatus 97 by printing or coating a third down film of ink or layer of coating material onto the freshly printed or coated substrate as it is simultaneously printed or coated on the last impression cylinder 36. Moreover, the mutual tack between the second down ink film or coating layer and the third down ink film or coating layer causes the overprinted or overcoated substrate to cling to the plate or blanket, thus opposing or resisting separation of the substrate from the plate or blanket.

To remedy this problem, a vacuum-assisted transfer apparatus 99 is mounted adjacent the modified or converted delivery cylinder 42 as shown in FIG. 3 and FIG. 4. Another purpose of the vacuum-assisted transfer apparatus 99 is to separate the freshly overprinted or overcoated triple bump substrate from the plate or blanket B as the substrate transfers through the nip. The vacuum-assisted transfer apparatus 99 produces a pressure differential across the freshly overprinted or overcoated substrate as it transfers through the nip, thus producing a separation force onto the substrate and providing a clean separation from the plate or blanket B

The vacuum-assisted transfer apparatus 99 is preferably constructed as described in U.S. Pat. Nos. 5,113,255; 5,127,329; 5,205,217; 5,228,391; 5,243,909; and 5,419,254, all to Howard W. DeMoore, co-inventor, which are incorporated herein by reference. The vacuum-assisted transfer apparatus 99 is manufactured and sold by Printing Research, Inc. of Dallas, Tex., U.S.A. under its trademark BACVAC™.

Although the present invention and its advantages have been described in detail, it should be understood that various changes, substitutions and alterations can be made herein without departing from the spirit and scope of the present invention as defined by the appended claims.

What is claimed is:

1. A rotary offset printing press of the type including first and second printing units, the first printing unit comprising,

a plate cylinder having a flexographic printing plate mounted thereon;

a blanket cylinder having a blanket disposed in ink or coating transfer engagement with the flexographic printing plate for receiving aqueous or flexographic printing ink or coating material from the flexographic printing plate;

an impression cylinder disposed adjacent the blanket cylinder thereby forming a nip between the blanket and the impression cylinder whereby the aqueous or flexographic printing ink or coating material can be transferred from the blanket to a substrate as the substrate is transferred through the nip;

inking/coating apparatus movably coupled to the first printing unit for movement to an on-impression operative position and to an off-impression retracted position;

the inking/coating apparatus including container means for containing a volume of aqueous or flexographic ink or coating material, and at least one applicator roller coupled to the container means for applying aqueous or flexographic ink or coating material to the flexographic printing plate or to the blanket when the inking/coating apparatus is in the on-impression operative position;

the container means having a partition dividing the container means thereby defining a first container region and a second container region;

the at least one applicator roller having first and second transfer surfaces and means separating the first and second transfer surfaces; and,

the first and second transfer surfaces of the at least one applicator roller being disposed within the first and second container regions for rolling contact with aqueous or flexographic printing ink or coating material contained within the first and second container regions, respectively.

2. A rotary offset printing press as defined in claim 1, wherein:

said separating means is an annular seal element disposed on the applicator roller; and,

the partition is disposed in sealing engagement against the annular seal element of the applicator roller.

3. A rotary offset printing press as defined in claim 1, wherein:

said container means is an open fountain pan;

said separating means is an annular groove intersecting the applicator roller thereby separating the first and second transfer surfaces; and,

the partition is a separator plate mounted on the fountain pan between the first and second container regions and disposed in the annular groove.

4. A rotary offset printing press as defined in claim 1, including sheet feeding means coupled to the first printing unit for consecutively feeding substrates in sheet form into the first printing unit.

5. A rotary offset printing press as defined in claim 1, including web feeding means coupled to the first printing unit for continuously feeding a substrate in continuous web form into the first printing unit.

6. A rotary offset printing press as defined in claim 1, wherein:

said container means is a fountain pan having first and second pan sections for containing first and second aqueous or flexographic inks or coating materials, respectively; and,

said at least one applicator roller is a pan roller mounted for rotation in the first and second pan sections, respectively, for separately transferring aqueous or flexographic ink or coating material from the first and second pan sections to the first and second transfer surfaces of the applicator roller.

7. A rotary offset printing press as set forth in claim 1, wherein:

said container means is a sealed doctor blade head, said partition being mounted on the doctor blade head and separating the first and second container regions;

the at least one applicator roller comprising an anilox transfer roller;

the separating means being a seal band formed on the applicator roller between the first and second transfer surfaces; and,

the partition being disposed in sealing engagement with the seal band in the coupled position.

8. A rotary offset printing press as defined in claim 1, wherein the inking/coating apparatus comprises.

first cradle means for supporting the at least one applicator roller for engagement with a plate or blanket when the inking/coating apparatus is in the operative position;

second cradle means for supporting a second applicator roller for engagement with a plate or blanket when the inking/coating apparatus is in the operative position;

the at least one applicator roller being mounted for rotation on the first cradle means, the at least one applicator roller having a first seal band separating first and second transfer surfaces;

the second applicator roller being mounted for rotation on the second cradle means, the second applicator roller having a second seal band separating the third and fourth transfer surfaces;

the container means including:

first reservoir means for containing a volume of ink or coating material, the first reservoir means having first and second reservoir chambers and a first partition separating the first and second reservoir chambers;

second reservoir means for containing a volume of ink or coating material, the second reservoir means having third and fourth reservoir chambers and a second partition element separating the third and fourth reservoir chambers;

the first and second reservoir means being coupled to the at least one and second applicator rollers, respectively, the first and second transfer surfaces of the at least one applicator roller being disposed for rolling contact with ink or coating material in the first and second reservoir chambers, respectively, of the first reservoir means and the first partition being disposed in sealing engagement with the separating means of the first applicator roller; and,

the third and fourth transfer surfaces of the second applicator roller being disposed for rolling contact with ink or coating material in the third and fourth reservoir chambers, respectively, of the second reservoir means and the second partition being disposed in sealing engagement with the separating means of the second applicator roller.

9. A rotary offset printing press as defined in claim 1, wherein:

the at least one applicator roller is an anilox roller; and,

the volumetric capacity of the first transfer surface being different from the volumetric capacity of the second transfer surface.

10. A rotary offset printing press as defined in claim 1, wherein the inking/coating apparatus comprises:

cradle means;

the at least one applicator roller being mounted for rotation on the cradle means; and,

the volumetric capacity of the first transfer surface being different from the volumetric capacity of the second transfer surface.

11. A rotary offset printing press as defined in claim 1, further including:

a transfer drum coupled in substrate transfer relation with the impression cylinder of the first printing unit and in substrate transfer relation with the second printing unit,

a first dryer mounted adjacent the impression cylinder of the first printing unit for discharging heated air onto a freshly printed or coated substrate while the substrate is in contact with the impression cylinder of the first printing unit;

a second dryer mounted adjacent the transfer drum for discharging heated air onto a freshly printed or coated substrate after it has been transferred from the impression cylinder of the first printing unit and while it is in contact with the transfer cylinder; and,

a third dryer disposed adjacent the second printing unit for discharging heated air onto a freshly printed or coated substrate after it has been transferred from the transfer drum and before it is printed or otherwise processed on the second printing unit.

12. A rotary offset printing press as defined in claim 1, wherein the inking/coating apparatus comprises:

first cradle means;

a first reservoir or fountain means mounted on the first cradle means for containing ink or coating material;

a first applicator roller mounted for rotation on the first cradle means and disposed for rolling contact with ink or coating material in the first reservoir or fountain means, the first applicator roller being engagable with a printing plate on the plate cylinder;

second cradle means;

a second reservoir or fountain means mounted on the second cradle means for receiving ink or coating material; and,

a second applicator roller mounted for rotation on the second cradle means and disposed for rolling contact with ink or coating material in the second reservoir or fountain means, the second applicator roller being engagable with a printing plate or blanket mounted on the blanket cylinder in the operative position.

13. A rotary offset printing press as defined in claim 1, wherein the inking/coating apparatus has an axis of rotation and is pivotally mounted on the first printing unit in a position in which the nip contact point between said at least one applicator roller and a blanket or plate is offset with respect to a radius line projecting through the center of the plate cylinder or blanket cylinder to the axis of rotation of the inking/coating apparatus.

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US005651316A

United States Patent [19]

DeMoore et al.

[11] Patent Number: 5,651,316

[45] Date of Patent: Jul. 29, 1997

[54] RETRACTABLE PRINTING/COATING UNIT OPERABLE ON THE PLATE AND BLANKET CYLINDERS SIMULTANEOUSLY FROM THE DAMPENER SIDE OF THE FIRST PRINTING UNIT OR ANY CONSECUTIVE PRINTING UNIT OF ANY ROTARY OFFSET PRINTING PRESS

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[73] Assignee: Howard W. DeMoore, Dallas, Tex.

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[22] Filed: Oct. 2, 1995

[51] Int. Cl.[6] B41M 4/00

[52] U.S. Cl. 101/450.1; 118/46; 101/424.1

[58] Field of Search 101/424.1, 450.1, 101/135, 141, 142, 211, 216, 232, 348–349; 118/46

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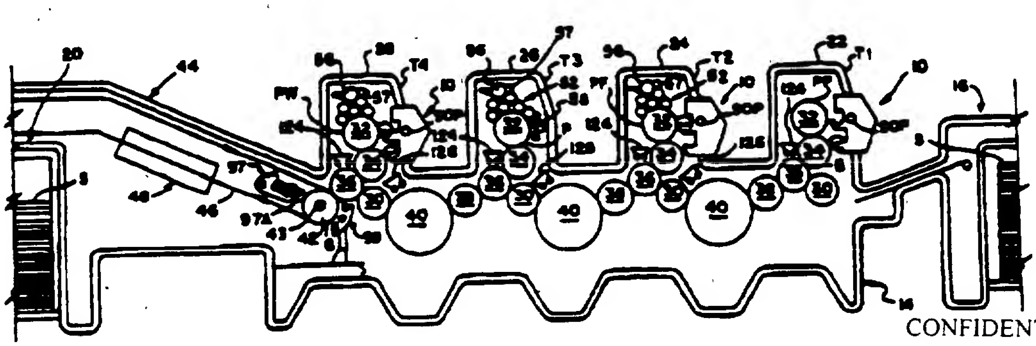
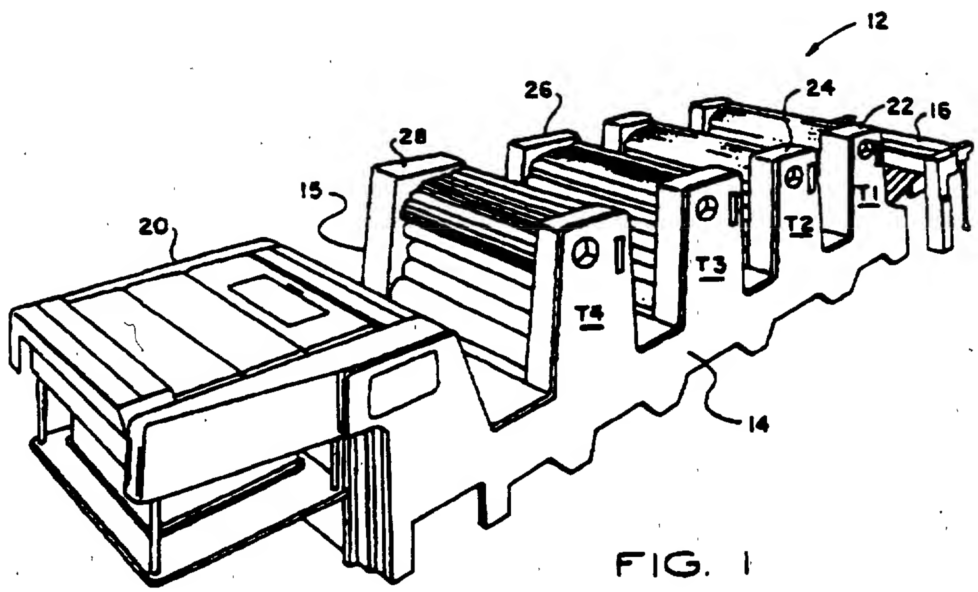
Primary Examiner—Eugene H. Eickholt
Attorney, Agent, or Firm—Sidley & Austin

[57] ABSTRACT

A retractable in-line inking/coating apparatus can apply either spot or overall inking/coating material to a plate and/or a blanket on the first printing unit or on any consecutive printing unit of any rotary offset printing press. The inking/coating apparatus is pivotally mounted within the conventional dampener space of any lithographic printing unit. The aqueous component of the flexographic printing ink or aqueous coating material is evaporated and dried by high velocity, hot air dryers and high performance heat and moisture extractors so that the aqueous or flexographic ink or coating material on a freshly printed or coated sheet is dry and can be dry-trapped on the next printing unit. The inking/coating apparatus includes dual cradles that support first and second applicator rollers so that the inking/coating apparatus can apply a double bump of aqueous/flexographic or UV-curable printing ink or coating material to a plate on the plate cylinder, while simultaneously applying aqueous, flexographic or UV-curable printing ink or coating material to a plate or a blanket on the blanket cylinder, and thereafter onto a sheet as the sheet is transferred through the nip between the blanket cylinder and the impression cylinder. A triple bump is printed or coated on the last printing unit with the aid of an impression cylinder inking/coating unit.

16 Claims, 10 Drawing Sheets

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T4
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FIG. 1

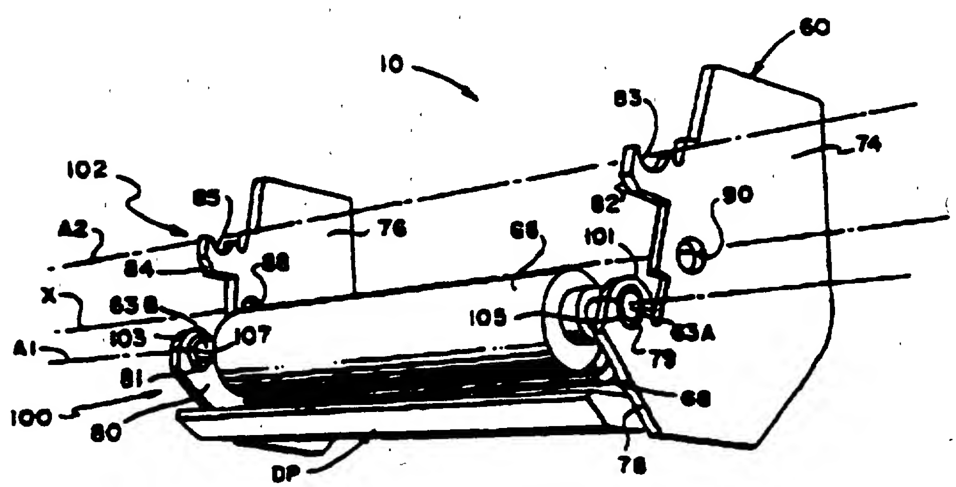
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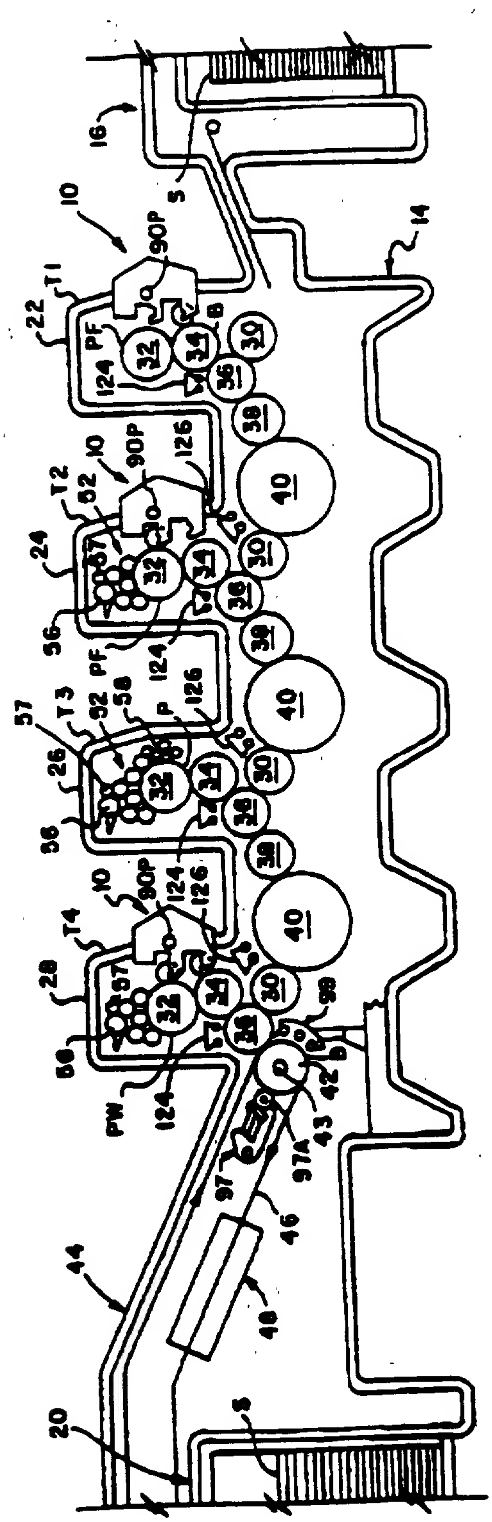
FIG. 2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S
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T1
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PF
B
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T2
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52
57
56
T3
26
58
P
T4
28
PW
42
43
97A
97
46
44
48
98
20

FIG. 3

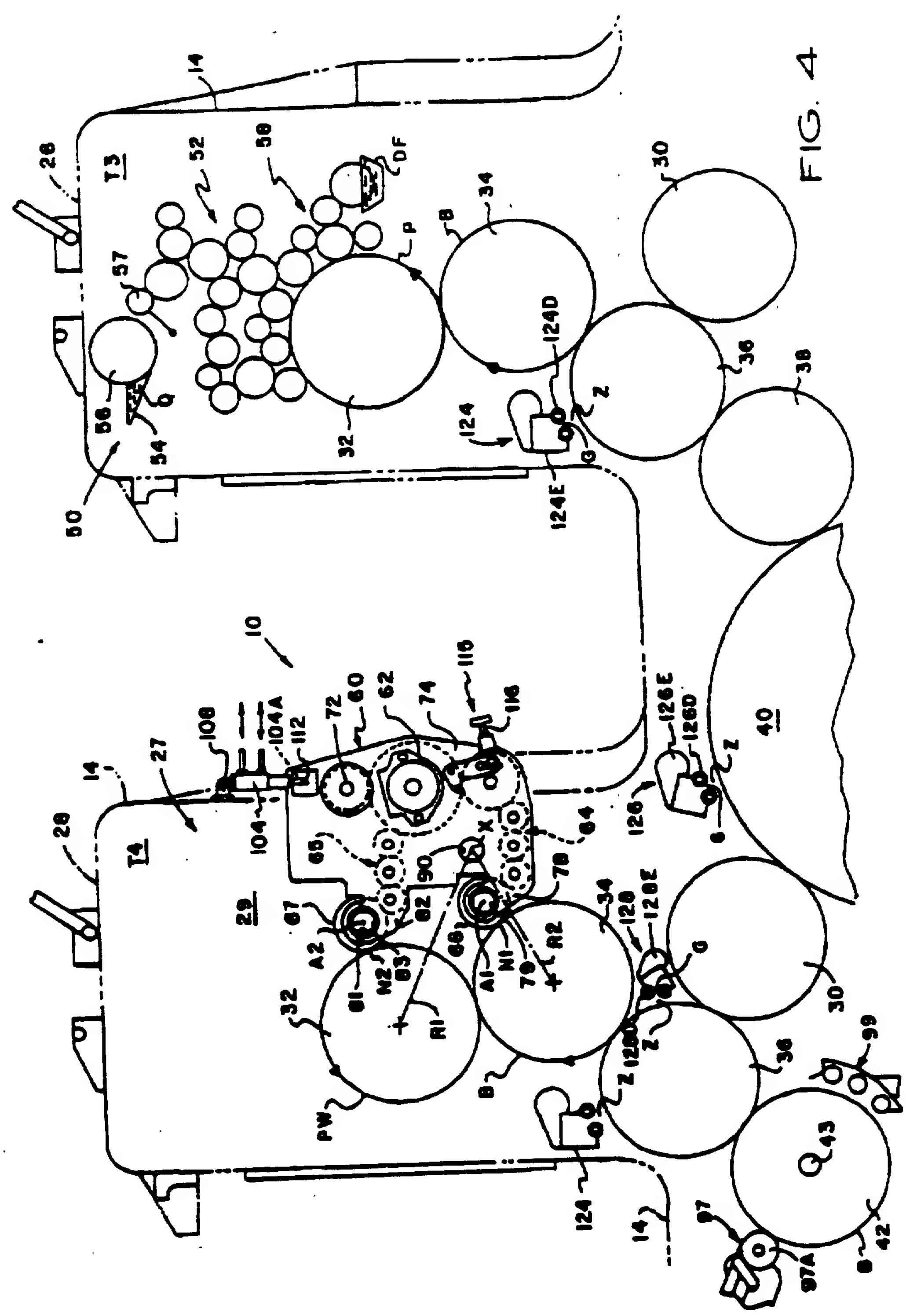

FIG. 4

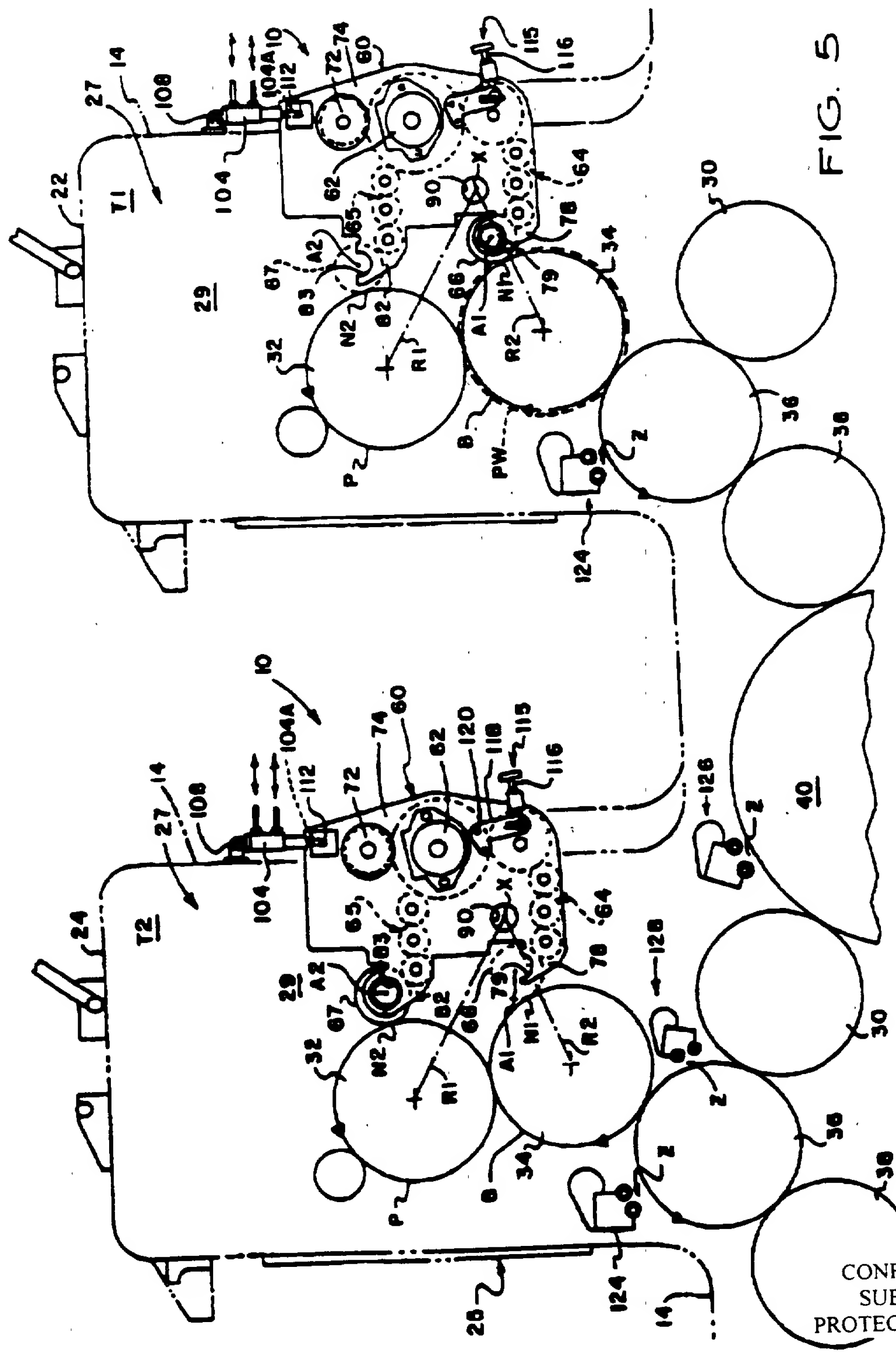

FIG. 5

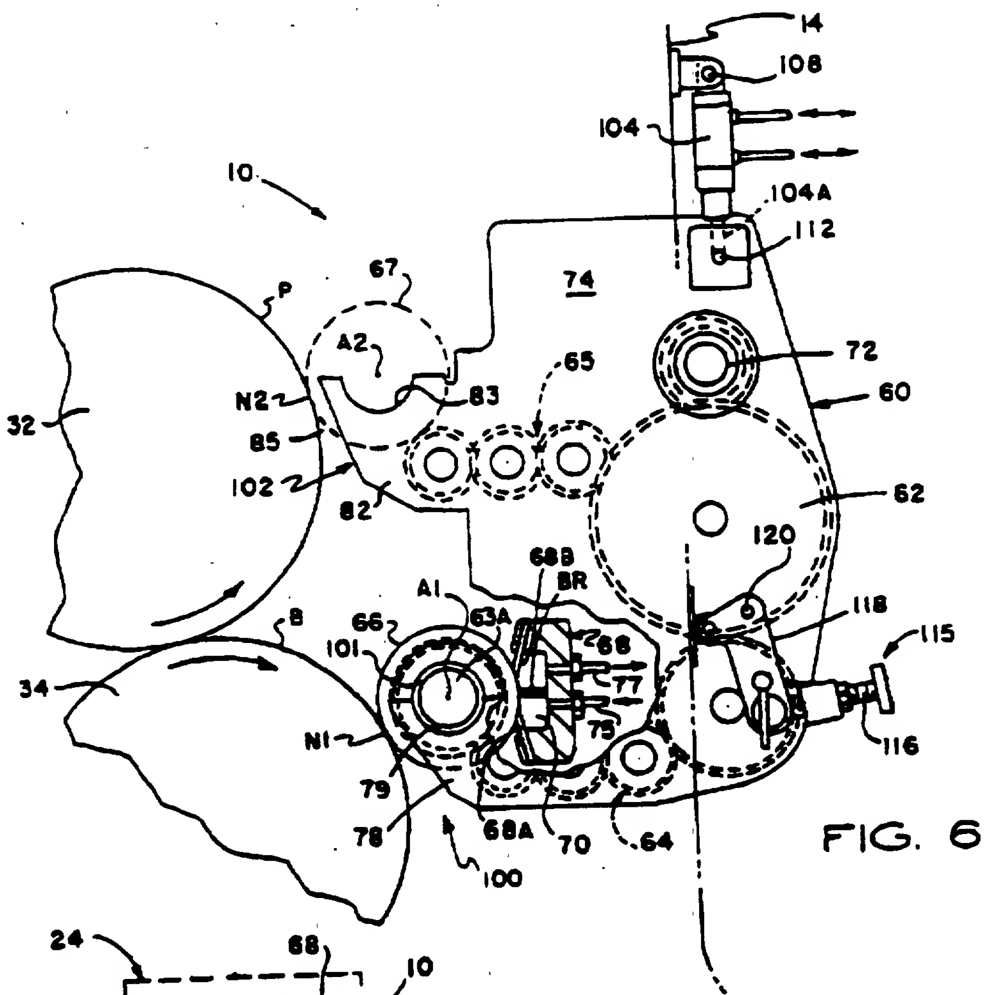
14
108
104
104A
112
10
74
67
P
A2
72
65
60
32
N2
83
85
102
82
62
120
68B
BR
A1
118
115
B
66
63A
68
101
77
34
75
N1
116
79
78
68A
70
64
100

FIG. 6

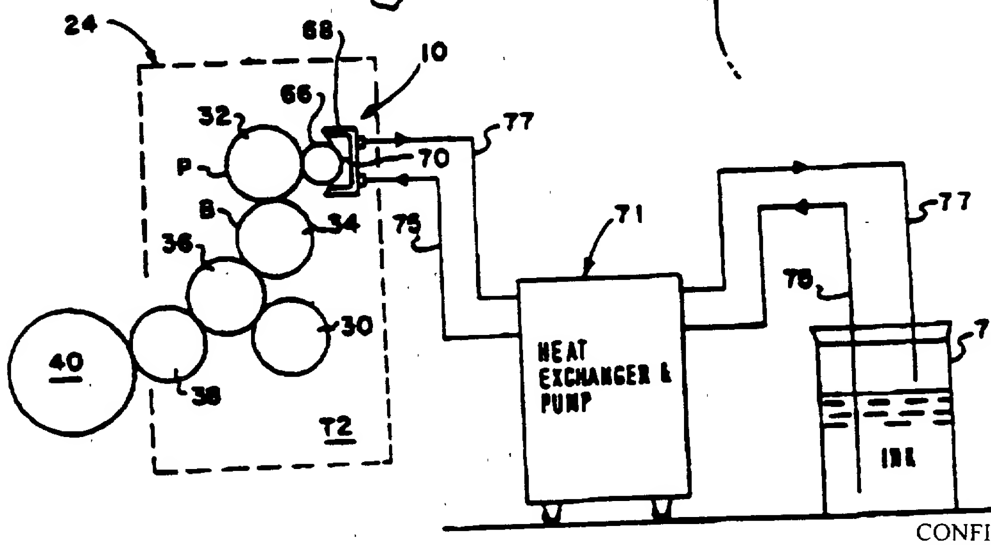
24
68
10
66
32
77
P
70
B
34
71
75
77
36
76
30
73
40
38
T2
HEAT EXCHANGER & PUMP
INK

FIG. 7

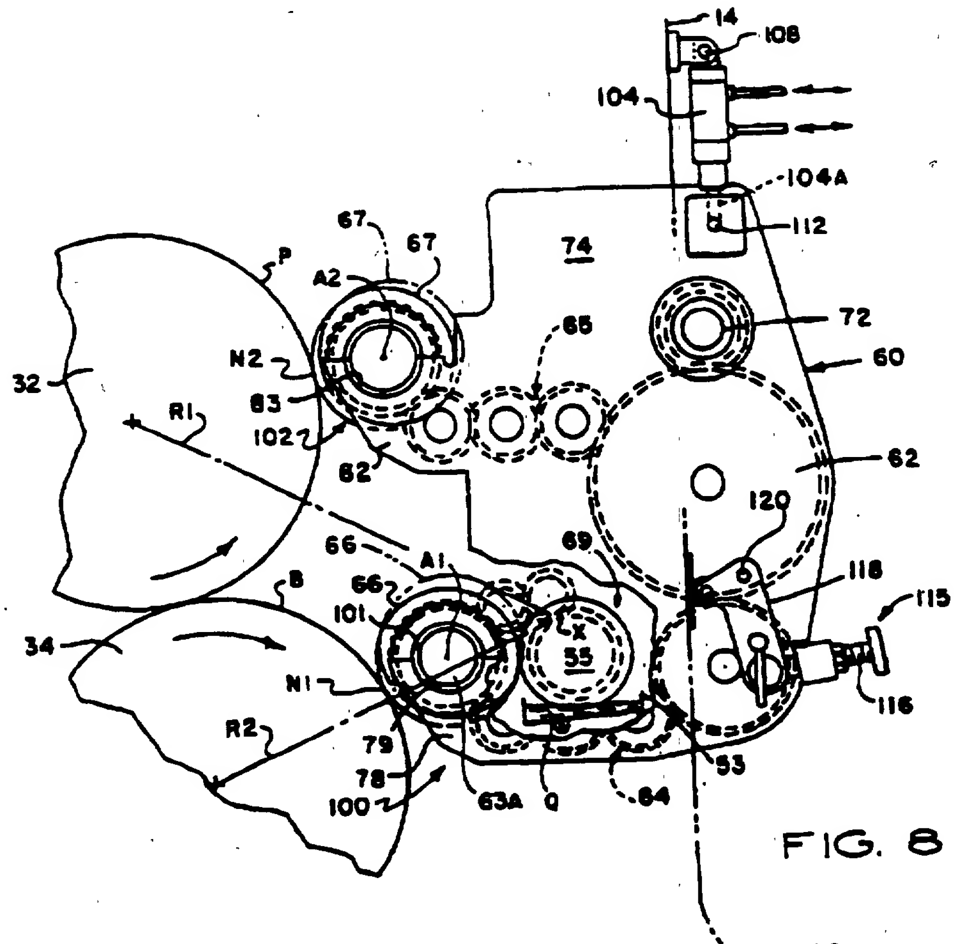
14
108
104
104A
112
74
67
67
P
A2
72
60
65
N2
83
32
R1
102
82
62
120
66
A1
69
118
115
B
66
101
X
55
34
N1
116
R2
79
78
53
100
63A
Q
84

FIG. 8

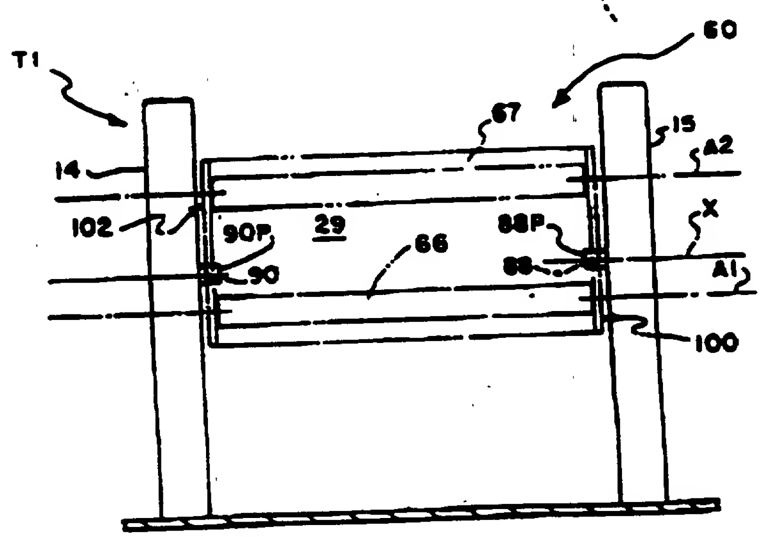
60
T1
67
15
14
A2
102
90P
29
88P
X
66
90
88
A1
100

FIG. 9

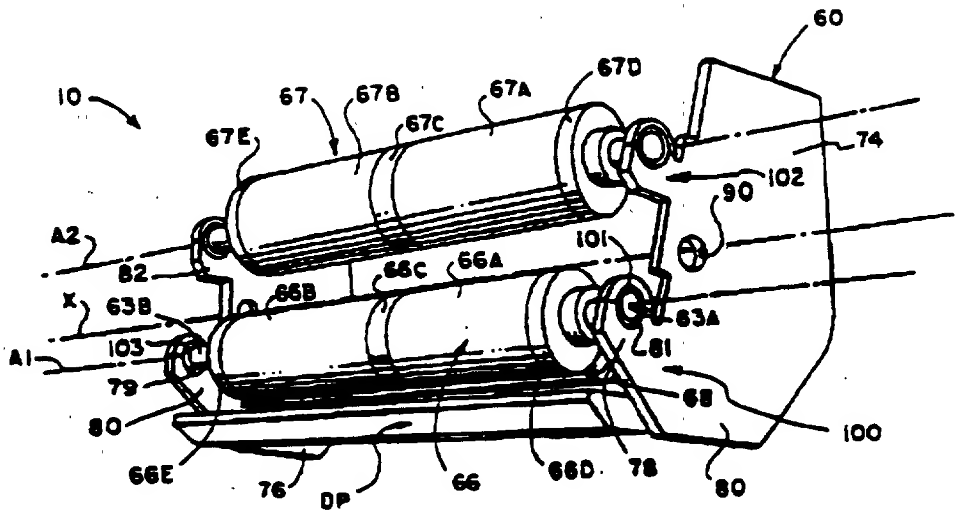

FIG. 10

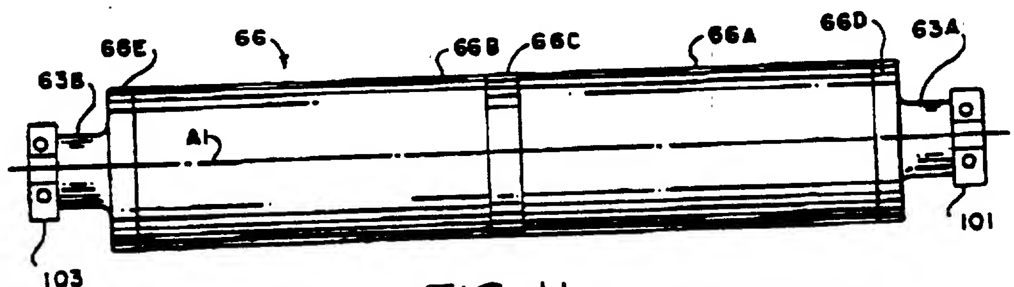

FIG. 11

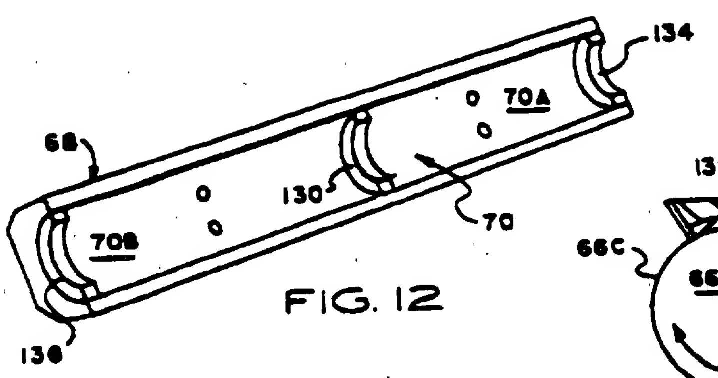

FIG. 12

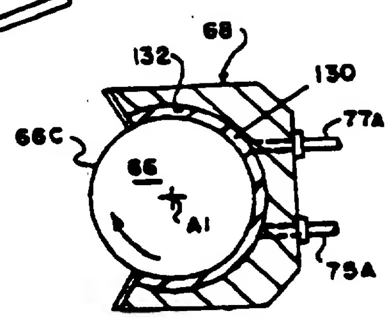

FIG. 13

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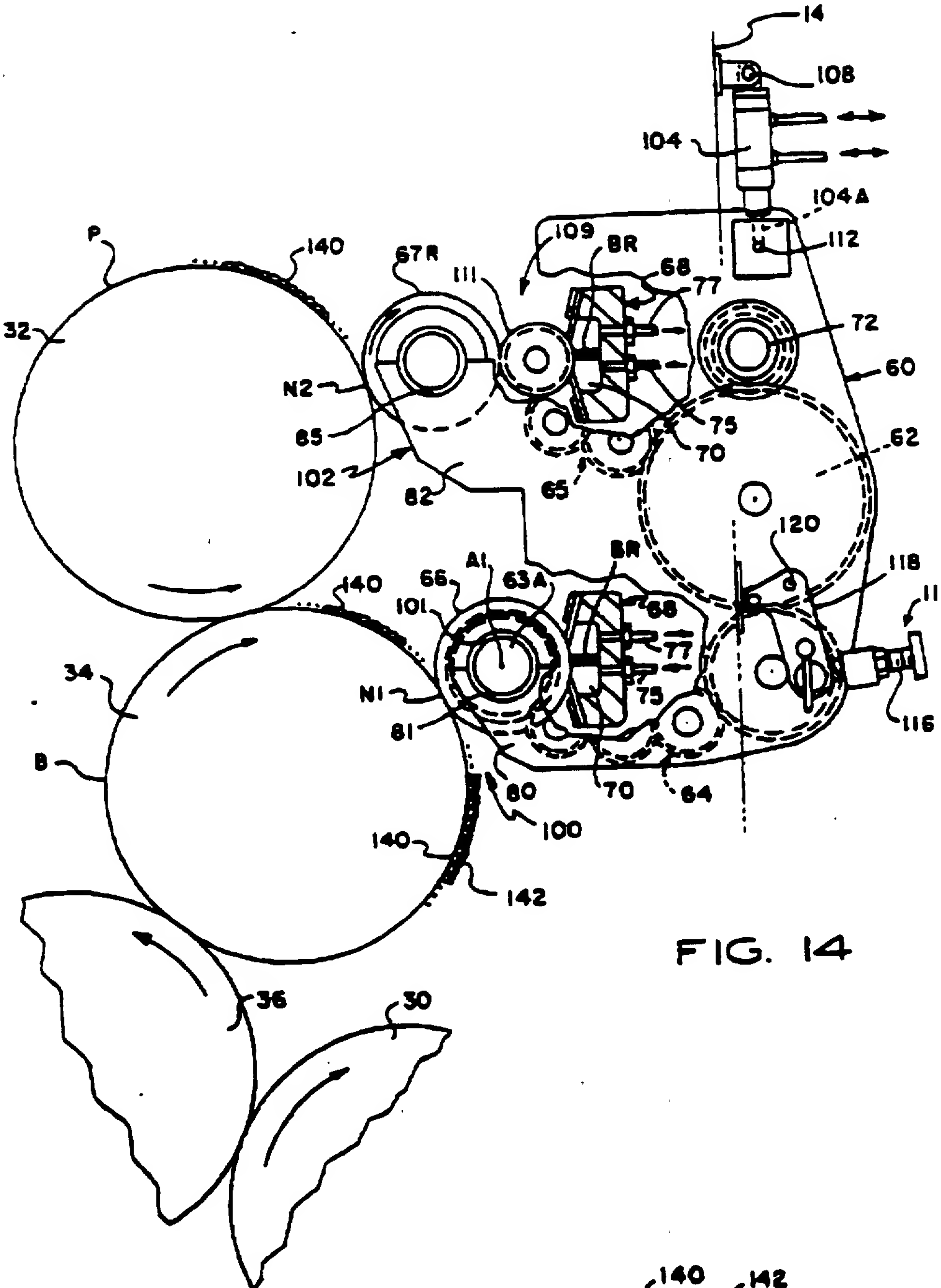
14
108
104
104A
112
109
BR
68
77
72
60
P
140
67R
111
32
N2
75
85
70
62
102
82
65
120
BR
118
140
66
A1
63A
115
101
68
77
34
N1
75
116
81
B
80
70
64
100
140
142
36
30

FIG. 14


140
142
S

FIG. 15

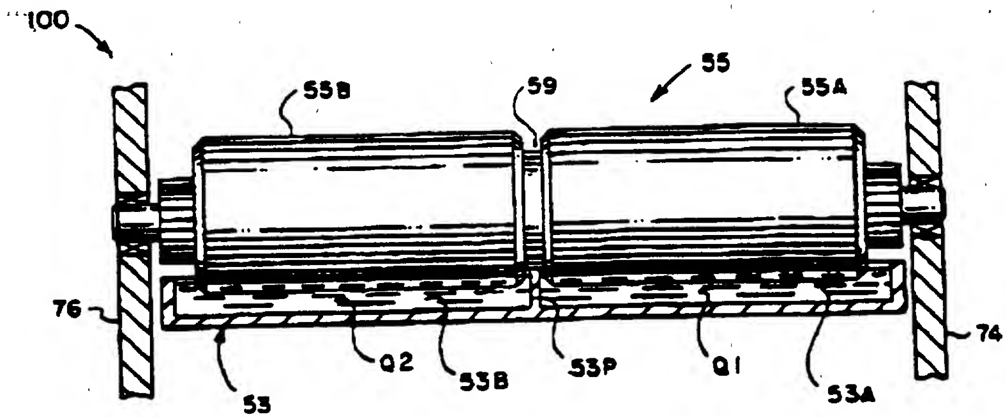

FIG. 16

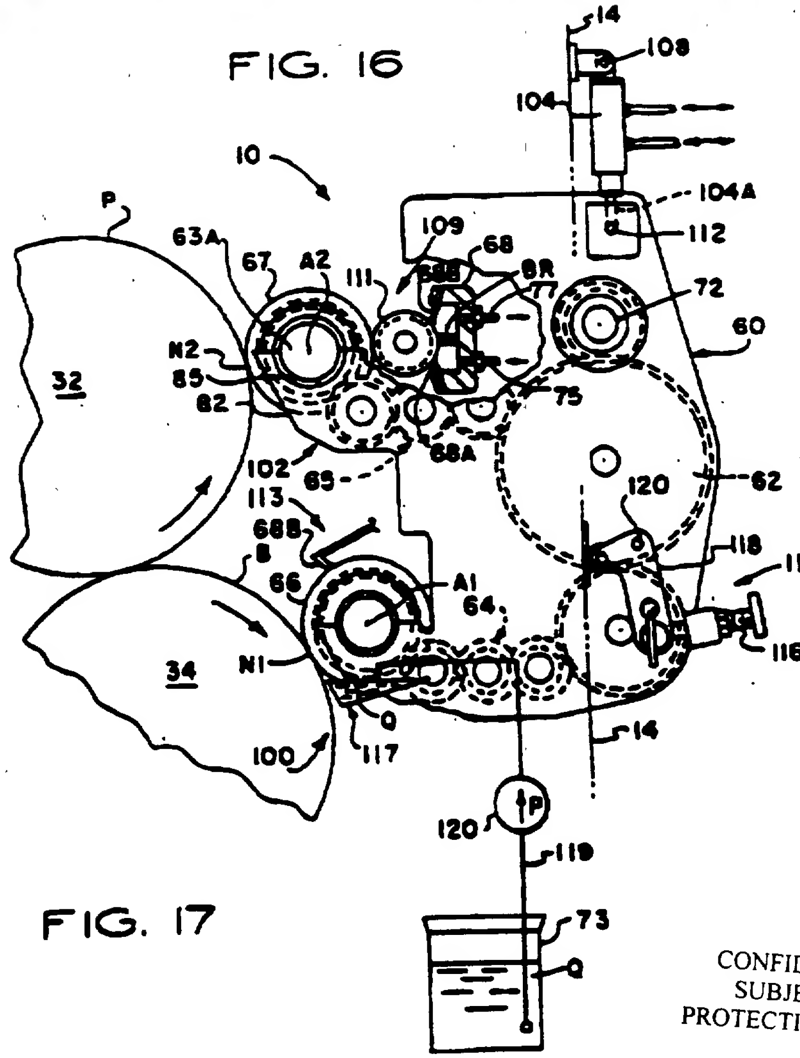

FIG. 17

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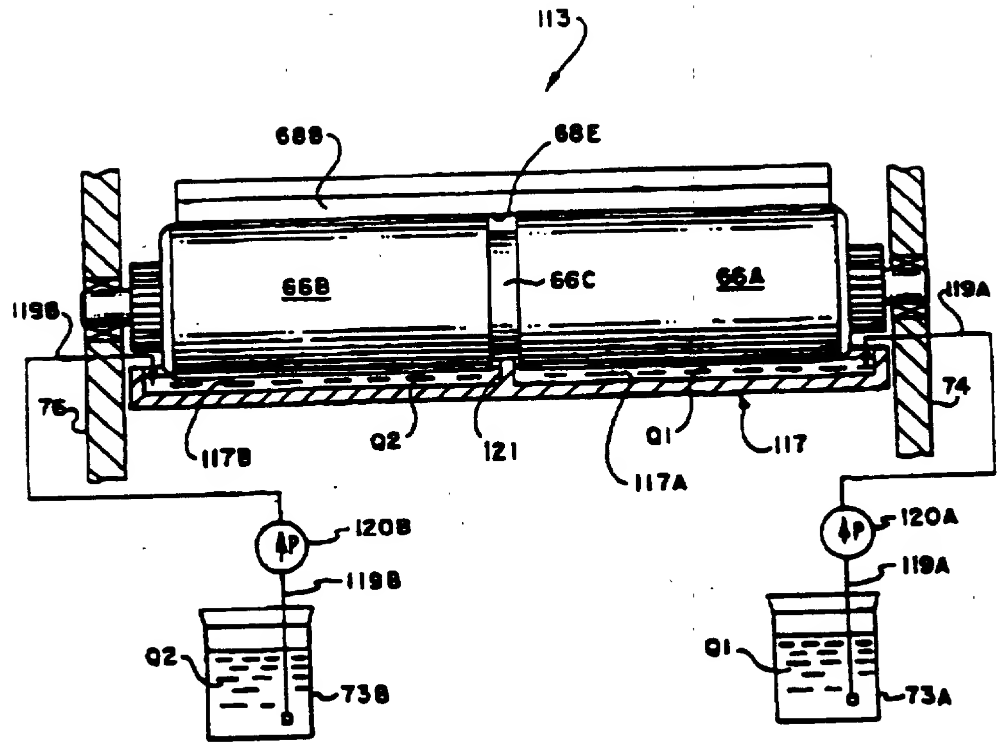
113
68B
68E
66B
66C
66A
119B
119A
76
74
117B
Q2
121
Q1
117
117A
120B
120A
119B
119A
Q2
73B
Q1
73A

FIG. 18

RETRACTABLE PRINTING/COATING UNIT OPERABLE ON THE PLATE AND BLANKET CYLINDERS SIMULTANEOUSLY FROM THE DAMPENER SIDE OF THE FIRST PRINTING UNIT OR ANY CONSECUTIVE PRINTING UNIT OF ANY ROTARY OFFSET PRINTING PRESS

FIELD OF THE INVENTION

This invention relates generally to sheet-fed or web-fed, rotary offset lithographic printing presses, and more particularly, to a new and improved inking/coating apparatus for the in-line application of aqueous or flexographic printing inks, primer or protective/decorative coatings applied simultaneously to the plate and blanket of the first or any consecutive printing unit of any lithographic printing press.

BACKGROUND OF THE INVENTION

Conventional sheet-fed, rotary offset printing presses typically include one or more printing units through which individual sheets are fed and printed. After the last printing unit, freshly printed sheets are transferred by a delivery conveyor to the delivery end of the press where the freshly printed and/or coated sheets are collected and stacked uniformly. In a typical sheet-fed, rotary offset printing press such as the Heidelberg Speedmaster line of presses, the delivery conveyor includes a pair of endless chains carrying gripper bars with gripper fingers which grip and pull freshly printed sheets from the last impression cylinder and convey the sheets to the sheet delivery stacker.

Since the inks used with sheet fed rotary offset printing presses are typically wet and tacky, special precautions must be taken to prevent marking and smearing of the freshly printed or coated sheets as the sheets are transferred from one printing unit to another. The printed ink on the surface of the sheet dries relatively slowly and is easily smeared during subsequent transfer between printing units. Marking, smearing and smudging can be prevented by a vacuum assisted sheet transfer apparatus as described in the following U.S. Pat. Nos. 5,113,255; 5,127,329; 5,205,217; 5,228,391; 5,243,909; and 5,419,254, all to Howard W. DeMoore, co-inventor, and manufactured and sold by Printing Research, Inc. of Dallas, Tex., U.S.A. under its trademark BACVAC®.

In some printing jobs, offsetting is prevented by applying a protective and/or decorative coating material over all or a portion of the freshly printed sheets. Some coatings are formed of a UV-curable or water-dispersed resin applied as a liquid solution over the freshly printed sheets to protect the ink from offsetting or set-off and improve the appearance of the freshly printed sheets. Such coatings are particularly desirable when decorative or protective finishes are applied in the printing of posters, record jackets, brochures, magazines, folding cartons and the like.

DESCRIPTION OF THE PRIOR ART

Various arrangements have been made for applying the coating as an in-line printing operation by using the last printing unit of the press as the coating application unit. For example, U.S. Pat. Nos. 4,270,483; 4,685,414; and 4,779,557 disclose coating apparatus which can be moved into position to permit the blanket cylinder of the last printing unit of a printing press to be used to apply a coating material over the freshly printed sheets. In U.S. Pat. No. 4,841,903 (Bird) there are disclosed coating apparatus which can be

selectively moved between the plate cylinder or the blanket cylinder of the last printing unit of the press so the last printing unit can only be used for coating purposes. However, when coating apparatus of these types are being used, the last printing unit cannot be used to print ink to the sheets, but rather can only be used for the coating operation. Thus, while coating with this type of in-line coating apparatus, the printing press loses the capability of printing on the last printing unit as it is converted to a coating unit.

The coater of U.S. Pat. No. 5,107,790 (Sliker et al) is retractable along an inclined rail for extending and retracting a coater head into engagement with a blanket on the blanket cylinder. Because of its size, the rail-retractable coater can only be installed between the last printing unit of the press and the delivery sheet stacker, and cannot be used for interunit coating. The coater of U.S. Pat. No. 4,615,293 (Jahn) provides two separate, independent coaters located on the dampener side of a converted printing unit for applying lacquer to a plate and to a rubber blanket. Consequently, although a plate and blanket are provided, the coating unit of Jahn's press is restricted to a dedicated coating operation only.

Proposals have been made for overcoming the loss of a printing unit when in-line coating is used, for example as set forth in U.S. Pat. No. 5,176,077 to Howard W. DeMoore (co-inventor and assignee), which discloses a coating apparatus having an applicator roller positioned to apply the coating material to the freshly printed sheet while the sheet is still on the last impression cylinder of the press. This allows the last printing unit to print and coat simultaneously, so that no loss of printing unit capability results.

Some conventional coaters are rail-mounted and occupy a large amount of press space and reduce access to the press. Elaborate equipment is needed for retracting such coaters from the operative coating position to the inoperative position, which reduces access to the printing unit.

Accordingly, there is a need for an in-line inking/coating apparatus which does not result in the loss of a printing unit, does not extend the length of the press, and which can print and coat aqueous and flexographic inks and coating materials simultaneously onto the plate and blanket on any lithographic printing unit of any lithographic printing press, including the first printing unit.

OBJECTS OF THE INVENTION

Accordingly, a general object of the present invention is to provide improved inking/coating apparatus which is capable of selectively applying ink or coating material to a plate on a plate cylinder or ink or coating material to a plate or blanket on a blanket cylinder.

A specific object of the present invention is to provide improved inking/coating apparatus of the character described which is extendable into inking/coating engagement with either a plate on a plate cylinder or to a plate or blanket on a blanket cylinder.

A related object of the present invention is to provide improved inking/coating apparatus of the character described which is capable of being mounted on any lithographic printing unit of the press and does not interfere with operator access to the plate cylinder, blanket cylinder, or adjacent printing units.

Another object of the present invention is to provide improved inking/coating apparatus of the character described, which can be moved from an operative inking/coating engagement position adjacent to a plate cylinder or a blanket cylinder to a non-operative, retracted position.

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Still another object of the present invention is to provide improved inking/coating apparatus of the character described, which can be used for applying aqueous, flexographic and ultra-violet curable inks and/or coatings in combination with lithographic, flexographic and waterless printing processes on any rotary offset printing press.

A related object of the present invention is to provide improved inking/coating apparatus of the character described, which is capable of applying aqueous or flexographic ink or coating material on one printing unit, for example the first printing unit, and drying the ink or coating material before it is printed or coated on the next printing unit so that it can be overprinted or overcoated immediately on the next printing unit with waterless, aqueous, flexographic or lithographic inks or coating materials.

Yet another object of the present invention is to provide improved inking/coating apparatus for use on a multiple color rotary offset printing press that can apply ink or coating material separately and/or simultaneously to the plate and/or blanket of a printing unit of the press from a single operative position, and from a single inking/coating apparatus.

A related object of the present invention is to provide improved inking/coating apparatus of the character described, in which virtually no printing unit adjustment or alteration is required when the inking/coating apparatus is converted from plate to blanket printing or coating and vice versa.

Another object of the present invention is to provide improved inking/coating apparatus that can be operably mounted in the dampener space of any lithographic printing unit for inking/coating engagement with either a plate on a plate cylinder or a plate or blanket on a blanket cylinder, and which does not interfere with operator movement or activities in the interunit space between printing units.

SUMMARY OF THE INVENTION

The foregoing objects are achieved by a retractable, in-line inking/coating apparatus which is mounted on the dampener side of any printing unit of a rotary offset press for movement between an operative (on-impression) inking/coating position and a retracted, disengaged (off-impression) position. The inking/coating apparatus includes an applicator roller which is movable into and out of engagement with a plate on a plate cylinder or a blanket on a blanket cylinder. The inking/coating applicator head is pivotally coupled to a printing unit by pivot pins which are mounted on the press side frames in the traditional dampener space of the printing unit in parallel alignment with the plate cylinder and the blanket cylinder. This dampener space mounting arrangement allows the inking/coating unit to be installed between any adjacent printing units on the press.

In the preferred embodiment, the applicator head includes vertically spaced pairs of cradle members with one cradle pair being adapted for supporting an inking/coating applicator roller in alignment with a plate cylinder, and the other cradle pair supporting an inking/coating applicator roller in alignment with the blanket cylinder, respectively, when the applicator head is in the operative position. Because of the pivotal support provided by the pivot pins, the applicator head can be extended and retracted within the limited space available in the traditional dampener space, without restricting operator access to the printing unit cylinders and without causing a printing unit to lose its printing capability.

When the inking/coating apparatus is used in combination with a flexographic printing plate and aqueous or flexographic ink or coating material, the water component of the aqueous or flexographic ink or coating material on the freshly printed or coated sheet is evaporated and dried by a high velocity, hot air interunit dryer and a high volume heat and moisture extractor assembly so that the freshly printed ink or coating material is dry before the sheet is printed or coated on the next printing unit. This quick drying process permits a base layer or film of ink, for example opaque white or metallic (gold, silver or other metallics) ink to be printed on the first printing unit, and then overprinted on the next printing unit without back-trapping or dot gain.

The construction and operation of the present invention will be understood from the following detailed description taken in conjunction with the accompanying drawings which disclose, by way of example, the principles and advantages of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a sheet fed, rotary offset printing press having inking/coating apparatus embodying the present invention;

FIG. 2 is a simplified perspective view of the single head, dual cradle inking/coating apparatus of the present invention;

FIG. 3 is a schematic side elevational view of the printing press of FIG. 1 having single head, dual cradle inking/coating apparatus installed in the traditional dampener position of the first, second and last printing units;

FIG. 4 is a simplified side elevational view showing the single head, dual cradle inking/coating apparatus in the operative inking/coating position for simultaneously printing on the printing plate and blanket on the fourth printing unit;

FIG. 5 is a simplified side elevational view showing the single head, dual cradle inking/coating apparatus in the operative position for spot or overall inking or coating on the blanket of the first printing unit, and showing the dual cradle inking/coating apparatus in the operative position for spot or overall inking or coating on the printing plate of the second printing unit;

FIG. 6 is a simplified side elevational view of the single head, dual cradle inking/coating apparatus of FIG. 4 and FIG. 5, partially broken away, showing the single head, dual cradle inking/coating apparatus in the operative coating position and having a sealed doctor blade reservoir assembly for spot or overall coating on the blanket;

FIG. 7 is a schematic view showing a heat exchanger and pump assembly connected to the single head, dual cradle inking/coating apparatus for circulating temperature controlled ink or coating material to the inking/coating apparatus;

FIG. 8 is a side elevational view, partially broken away, and similar to FIG. 6 which illustrates an alternative coating head arrangement;

FIG. 9 is a simplified elevational view of a printing unit which illustrates pivotal coupling of the inking/coating apparatus on the printing unit side frame members;

FIG. 10 is a view similar to FIG. 2 in which a pair of split applicator rollers are mounted in the upper cradle and lower cradle, respectively;

FIG. 11 is a side elevational view of a split applicator roller;

FIG. 12 is a perspective view of a doctor blade reservoir which is centrally partitioned by a seal element;

FIG. 13 is a sectional view showing sealing engagement of the split applicator roller against the partition seal element of FIG. 12;

FIG. 14 is a view similar to FIG. 8 which illustrates an alternative inking/coating embodiment;

FIG. 15 is a simplified side elevational view of a substrate which has a bronzed-like finish which is applied by simultaneous operation of the dual applicator roller embodiment of FIG. 14;

FIG. 16 is a side elevational view, partly in section, of a pan roller having separate transfer surfaces mounted on a split fountain pan;

FIG. 17 is a simplified side elevational view of the dual cradle inking/coating apparatus, partially broken away, which illustrates an alternative inking/coating head apparatus featuring a single doctor blade assembly, anilox applicator roller mounted on the lower cradle; and

FIG. 18 is a side elevational view, partly in section, of a single doctor blade anilox applicator roller assembly having separate transfer surfaces, and a split fountain pan having separate fountain compartments, with the separate fountain compartments being supplied with different inks or coating materials from separate off-press sources.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

As used herein, the term "processed" refers to printing and coating methods which can be applied to either side of a substrate, including the application of lithographic, waterless, UV-curable, aqueous and flexographic inks and/or coatings. The term "substrate" refers to sheet and web material. Also, as used herein, the term "waterless printing plate" refers to a printing plate having image areas and non-image areas which are oleophilic and oleophobic, respectively. "Waterless printing ink" refers to an oil-based ink which does not contain a significant aqueous component. "Flexographic plate" refers to a flexible printing plate having a relief surface which is wettable by flexographic ink or coating material. "Flexographic printing ink or coating material" refers to an ink or coating material having a base constituent of either water, solvent or UV-curable liquid. "UV-curable lithographic printing ink and coating material" refers to oil-based printing inks and coating materials that can be cured (dried) photomechanically by exposure to ultraviolet radiation, and that have a semi-paste or gel-like consistency. "Aqueous printing ink or coating material" refers to an ink or coating material that predominantly contains water as a solvent, diluent or vehicle. A "relief plate" refers to a printing plate having image areas which are raised relative to non-image areas which are recessed.

As shown in the exemplary drawings, the present invention is embodied in a new and improved in-line inking/coating apparatus, herein generally designated 10, for applying aqueous, flexographic or UV-curable inks or protective and/or decorative coatings to sheets or webs printed in a sheet-fed or web-fed, rotary offset printing press, herein generally designated 12. In this instance, as shown in FIG. 1, the inking/coating apparatus 10 is installed in a four unit rotary offset printing press 12, such as that manufactured by Heidelberger Druckmaschinen AG of Germany under its designation Heidelberg Speedmaster SM102 (40", 102 cm).

The press 12 includes a press frame 14 coupled at one end, herein the right end, to a sheet feeder 16 from which sheets, herein designated S, are individually and sequentially fed into the press, and at the opposite end, with a sheet delivery stacker 20 in which the freshly printed sheets are collected and stacked. Interposed between the sheet feeder 16 and the sheet delivery stacker 20 are four substantially identical sheet printing units 22, 24, 26 and 28 which can print four different colors onto the sheets as they are transferred through the press 12. The printing units are housed within printing towers T1, T2, T3 and T4 formed by side frame members 14, 15. Each printing tower has a delivery side 25 and a dampener side 27. A dampener space 29 is partially enclosed by the side frames on the dampener side of the printing unit.

As illustrated, the printing units 22, 24, 26 and 28 are substantially identical and of conventional design. The first printing unit 22 includes an in-feed transfer cylinder 30, a plate cylinder 32, a blanket cylinder 34 and an impression cylinder 36, all supported for rotation in parallel alignment between the press side frames 14, 15 which define printing unit towers T1, T2, T3 and T4. Each of the first three printing units 22, 24 and 26 have a transfer cylinder 38 disposed to transfer the freshly printed sheets from the adjacent impression cylinder and transfer the freshly printed sheets to the next printing unit via an intermediate transfer drum 40.

The last printing unit 28 includes a delivery cylinder 42 mounted on a delivery shaft 43. The delivery cylinder 42 supports the freshly printed sheet 18 as it is transferred from the last impression cylinder 36 to a delivery conveyor system, generally designated 44, which transfers the freshly printed sheet to the sheet delivery stacker 20. To prevent smearing during transfer, a flexible covering is mounted on the delivery cylinder 42, as described and claimed in U.S. Pat. No. 4,402,267 to Howard W. DeMoore, which is incorporated herein by reference. The flexible covering is manufactured and sold by Printing Research, Inc. of Dallas, Tex., U.S.A. under its trademark SUPER BLUE®. Optionally, a vacuum-assisted sheet transfer assembly manufactured and sold by Printing Research, Inc. of Dallas, Tex., U.S.A., under its trademark BACVAC® can be substituted for the delivery transfer cylinder 42 and flexible covering.

The delivery conveyor system 44 as shown in FIG. 3 is of conventional design and includes a pair of endless delivery gripper chains 46, only one of which is shown carrying at regular spaced locations along the chains, laterally disposed gripper bars having gripper fingers used to grip the leading edge of a freshly printed or coated sheet 18 after it leaves the nip between the impression cylinder 36 and delivery cylinder 42 of the last printing unit 28. As the leading edge is gripped by the gripper fingers, the delivery chains 46 pull the sheet away from the last impression cylinder 36 and convey the freshly printed or coated sheet to the sheet delivery stacker 20.

Prior to reaching the delivery sheet stacker, the freshly printed and/or coated sheets S pass under a delivery dryer 48 which includes a combination of infra-red thermal radiation, high velocity hot air flow and a high performance heat and moisture extractor for drying the ink and/or the protective/decorative coating. Preferably, the delivery dryer 48, including the high performance heat and moisture extractor is constructed as described in U.S. application Ser. No. 08/116,711, filed Sep. 3, 1993, entitled "Infra-Red Forced Air Dryer and Extractor" by Howard C. Secor, Ronald M. Rendleman and Paul D. Copenhaver, commonly assigned to the assignee of the present invention, Howard W. DeMoore, and licensed to Printing Research, Inc. of Dallas, Tex., U.S.A., which manufactures and markets the delivery dryer 48 under its trademark AIR BLANKET™.

In the exemplary embodiment shown in FIG. 3, the first printing unit 22 has a flexographic printing plate PF mounted on the plate cylinder, and therefore neither an inking roller train nor a dampening system is required. A

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flexographic printing plate PF is also mounted on the plate cylinder of the second printing unit 24. The form rollers of the inking roller train 52 shown mounted on the second printing unit 24 are retracted and locked off to prevent plate contact. Flexographic ink is supplied to the flexographic plate PF of the second printing unit 24 by the inking/coating apparatus 10.

A suitable flexographic printing plate PF is offered by E.I. du Pont de Nemours of Wilmington, Del., U.S.A., under its trademark CYREL®. Another source is BASF Aktiengesellschaft of Ludwigshafen, Germany, which offers a suitable flexographic printing plate under its trademark NYLOFLEX®.

The third printing unit 26 as illustrated in FIG. 3 and FIG. 4 is equipped for lithographic printing and includes an inking apparatus 50 having an inking roller train 52 arranged to transfer ink Q from an ink fountain 54 to a lithographic plate P mounted on the plate cylinder 32. This is accomplished by a fountain roller 56 and a doctor roller 57. The fountain roller 56 projects into the ink fountain 54, whereupon its surface picks up ink. The lithographic printing ink Q is transferred from the fountain roller 56 to the inking roller train 52 by the doctor roller 57. The inking roller train 52 supplies ink Q to the image areas of the lithographic printing plate P.

The lithographic printing ink Q is transferred from the lithographic printing plate P to an ink receptive blanket B which is mounted on the blanket cylinder 34. The inked image carried on the blanket B is transferred to a substrate S as the substrate is transferred through the nip between the blanket cylinder 34 and the impression cylinder 36.

The inking roller arrangement 52 illustrated in FIG. and FIG. 4 is exemplary for use in combination with lithographic ink printing plates P. It is understood that a dampening system 58 having a dampening fluid reservoir DF is coupled to the inking roller train 52 (FIG. 4), but is not required for water-less or flexographic printing.

The plate cylinder 32 of printing unit 28 is equipped with a waterless printing plate PW. Waterless printing plates are also referred to as dry planographic printing plates and are disclosed in the following U.S. Pat. Nos.: 3,910,187; Re. 30,670; 4,086,093; and 4,853,313. Suitable waterless printing plates can be obtained from Toray Industries, Inc. of Tokyo, Japan. A dampening system is not used for waterless printing, and waterless (oil-based) printing ink is used. The waterless printing plate PW has image areas and non-image areas which are oleophilic/hydrophilic and oleophobic/hydrophobic, respectively. The waterless printing plate PW is engraved or etched, with the image areas being recessed with respect to the non-image areas. The image area of the waterless printing plate PW is rolled-up with the flexographic or aqueous printing ink which is transferred by the applicator roller 66. Both aqueous and oil-based inks and coatings are repelled from the non-image areas, and are retained in the image areas. The printing ink or coating is then transferred from the image areas to an ink or coating receptive blanket B and is printed or coated onto a substrate S.

For some printing jobs, a flexographic plate PF or a waterless printing plate PW is mounted over a resilient packing such as the blanket B on the blanket cylinder 34, for example as indicated by phantom lines in printing unit 22 of FIG. 8. An advantage of this alternative embodiment is that the waterless plate PW or the flexographic plate PF are resiliently supported over the blanket cylinder by the underlying blanket B or other resilient packing. The radial deflection and give of the resilient blanket B provides uniform, positive engagement between the applicator roller 66 and a flexographic plate or waterless plate.

In that arrangement, a plate is not mounted on the plate cylinder 32; instead, a waterless plate PW is mounted on the blanket cylinder, and the inked image on the waterless printing plate is not offset but is instead transferred directly from the waterless printing plate PW to the substrate S. The water component of flexographic ink on the freshly printed sheet is evaporated by high velocity, hot air dryers and high volume heat and moisture extractors so that the freshly printed aqueous or flexographic ink is dried before the substrate is printed on the next printing unit.

Referring now to FIG. 2, FIG. 3 and FIG. 9, the inking/coating apparatus 10 is pivotally mounted on the side frames 14, 15 for rotation about an axis X. The inking/coating apparatus 10 includes a frame 60, a hydraulic motor 62, a lower gear train 64, an upper gear train 65, an applicator roller 66, a sealed doctor blade assembly 68 (FIG. 6), and a drip pan DP, all mounted on the frame 60. The external peripheral surface of the applicator roller 66 is wetted by contact with liquid coating material or ink contained in a reservoir 70.

The hydraulic motor 62 drives the applicator roller 66 synchronously with the plate cylinder 32 and the blanket cylinder 34 in response to an RPM control signal from the press drive (not illustrated) and a feedback signal developed by a tachometer 72. While a hydraulic drive motor is preferred, other drive means such as an electric drive motor or an equivalent can be used.

When using waterless printing plate systems, the temperature of the waterless printing ink and of the waterless printing plate must be closely controlled for good image reproduction. For example, for waterless offset printing with TORAY waterless printing plates PW, it is absolutely necessary to control the waterless printing plate surface and waterless ink temperature to a very narrow range, for example 24° C. (75° F.) to 27° C. (80° F.).

Referring to FIG. 7, the reservoir 70 is supplied with ink or coating which is temperature controlled by a heat exchanger 71. The temperature controlled ink or coating material is circulated by a positive displacement pump, for example a peristaltic pump, through the reservoir 70 and heat exchanger 71 from a source 73 through a supply conduit 75 and a return conduit 77. The heat exchanger 71 cools or heats the ink or coating material and maintains the ink or coating and the printing plate within the desired narrow temperature range.

According to one aspect of the present invention, aqueous/flexographic ink or coating material is supplied to the applicator roller 66, which transfers the aqueous/flexographic ink or coating material to the printing plate (FIG. 7), which may be a waterless printing plate or a flexographic printing plate. When the inking/coating apparatus is used for applying aqueous/flexographic ink or coating material to a waterless printing plate PW, the inking roller train 52 is not required, and is retracted away from the printing plate. Because the viscosity of aqueous/flexographic printing ink or coating material varies with temperature, it is necessary to heat or cool the aqueous/flexographic printing ink or coating material to compensate for ambient temperature variations to maintain the ink viscosity in a preferred operating range.

For example, the temperature of the printing press can vary from around 60° F. 15° C.) in the morning, to around 85° F. (29° C.) or more in the afternoon. The viscosity of

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aqueous/flexographic printing ink or coating material can be marginally high when the ambient temperature of the press is near 60° F. 15° C.), and the viscosity can be marginally low when the ambient temperature of the press exceeds 85° F. (29° C.). Consequently, it is desirable to control the temperature of the aqueous/flexographic printing ink or coating material so that it will maintain the surface temperature of waterless printing plates within the specified temperature range. Moreover, the ink/coating material temperature should be controlled to maintain the tack of the aqueous/flexographic printing ink or coating material within a desired range when the ink or coating material is being used in connection with flexographic printing processes.

The applicator roller 66 is preferably an anilox fluid metering roller which transfers measured amounts of printing ink or coating material to a plate or blanket. The surface of an anilox roller is engraved with an array of closely spaced, shallow depressions referred as "cells". Ink or coating from the reservoir 70 flows into the cells as the anilox roller turns through the reservoir. The transfer surface of the anilox roller is "doctored" (wiped or scraped) by dual doctor blades 68A, 68B to remove excess ink or coating material. The ink or coating metered by the anilox roller is that contained within the cells. The dual doctor blades 68A, 68B also seal the supply reservoir 70.

The anilox applicator roller 66 is cylindrical and may be constructed in various diameters and lengths, containing cells of various sizes and shapes. The volumetric capacity of an anilox roller is determined by cell size, shape and number of cells per unit area. Depending upon the intended application, the cell pattern may be fine (many small cells per unit area) or coarse (fewer large cells per unit area).

By supplying the ink or coating material through the inking/coating apparatus 10, more ink or coating material can be applied to the sheet S as compared with the inking roller train of a lithographic printing unit. Moreover, color intensity is stronger and more brilliant because the aqueous or flexographic ink or coating material is applied at a much heavier film thickness or weight than can be applied by the lithographic process, and the aqueous or flexographic colors are not diluted by dampening solution.

Preferably, the sealed doctor blade assembly 68 is constructed as described in U.S. Pat. No. 5,176,077 to Howard W. DeMoore, co-inventor and assignee, which is incorporated herein by reference. An advantage of using a sealed reservoir is that fast drying ink or coating material can be used. Fast drying ink or coating material can be used in an open fountain 53 (see FIG. 8); however, open air exposure causes the water and solvents in the fast-drying ink or coating material to evaporate faster, thus causing the ink or coating material to dry prematurely and change viscosity. Moreover, an open fountain emits unwanted odors into the press room. When the sealed doctor blade assembly is utilized, the pump (FIG. 7) which circulates ink or coating material to the doctor blade head is preferably a peristaltic pump, which does not inject air into the feeder lines which supply the ink or coating reservoir 70 and helps to prevent the formation of air bubbles and foam within the ink or coating material.

An inking/coating apparatus 10 having an alternative applicator roller arrangement is illustrated in FIGS. 10–13. In this arrangement, the engraved metering surface of the anilox applicator rollers 66, 67 are partitioned by smooth seal surfaces 66C which separates a first engraved peripheral surface portion 66A from a second engraved peripheral surface portion 66B. Likewise, smooth seal surfaces 66D, 66E are formed on the opposite end portions of the applicator roller 66 for engaging end seals 134, 136 (FIG. 12) of the doctor blade reservoir. The upper applicator roller 67 has engraved anilox metering surfaces 67A and 67B which are separated by a smooth seal band 67C.

Referring now to FIG. 12 and FIG. 13, the reservoir 70 of the doctor blade head 68 is partitioned by a curved seal element 130 to form two separate chambers 70A, 70B. The seal element 130 is secured to the doctor blade head within an annular groove 132. The seal element 130 is preferably made of polyurethane foam or other durable, resilient foam material. The seal element 130 is engaged by the seal band 66C, thus forming a rotary seal which blocks the leakage of ink or coating material from one reservoir chamber into the other reservoir chamber. Moreover, the seal band provides an unprinted or uncoated area which separates the printed or coated areas from each other, which is needed for work and turn printing jobs or other printing jobs which print two or more separate images onto the same substrate.

Another advantage of the split applicator roller embodiment is that it enables two or more flexographic inks or coating materials to be printed simultaneously within the same lithographic printing unit. That is, the reservoir chambers 70A, 70B of the upper doctor blade assembly can be supplied with gold ink and silver ink, for example, while the reservoir chambers 70A, 70B of the lower doctor blade assembly can be supplied with inks of two additional colors, for example opaque white ink and blue ink. This permits the opaque white ink to be overprinted with the gold ink, and the blue ink to be overprinted with the silver ink on the same printing unit on any lithographic press.

Moreover, a catalyst can be used in the upper doctor blade reservoir and a reactive ink or coating material can be used in the lower doctor blade reservoir. This can provide various effects, for example improved chemical resistance and higher gloss levels.

The split applicator roller sections 67A, 67B in the upper cradle position can be used for applying two separate inks or coating materials simultaneously, for example flexographic:, aqueous and ultra-violet curable inks or coating materials, to separate surface areas of the plate, while the lower applicator roller sections 66A, 66B can apply an initiator layer and a micro-encapsulated layer simultaneously to separate blanket surface areas. Optionally, the metering surface portions 66A, 66B can be provided with different cell metering capacities for providing different printing effects which are being printed simultaneously. For example, the screen line count on one half-section of an anilox applicator roller is preferably in the range of 200–600 lines per inch (79–236 lines per cm) for half-tone images, and the screen line count of the other half-section is preferably in the range of 100–300 lines per inch (39–118 lines per cm) for overall coverage, high weight applications such as opaque white. This split arrangement in combination with dual applicator rollers is particularly advantageous when used in connection with "work and turn" printing jobs.

Referring again to FIG. 8, instead of using the sealed doctor blade reservoir assembly 68 as shown in FIG. 6, an open fountain assembly 69 is provided by the fountain pan 53 which contains a volume of liquid ink Q or coating material. The liquid ink or coating material is transferred to the applicator roller 66 by a pan roller 55 which turns in contact with ink Q or coating material in the fountain pan. If a split applicator roller is used, the pan roller 55 is also split, and the pan is divided into two pan sections 53A, 53B by a separator plate 53P, as shown in FIG. 16.

In the alternative embodiment of FIG. 16, the pan roller 55 is divided into two pan roller sections 55A, 55B by a centrally located, annular groove 59. The separator plate 53P is received within and centrally aligned with the groove 59, but does not touch the adjoining roller faces. By this arrangement, two or more inks or coating materials Q1, Q2 are contained within the open pan sections 55A, 55B for transfer by the split pan roller sections 53A, 53B, respectively. This permits two or more flexographic inks or coating materials to be transferred to two separate image areas on the plate or on the blanket of the same printing unit. This arrangement is particularly advantageous for work and turn printing jobs or other printing jobs which print two or more separate images onto the same substrate.

The frame 60 of the inking/coating apparatus 10 includes side support members 74, 76 which support the applicator roller 66, gear train 64, gear train 65, doctor blade assembly 68 and the drive motor 62. The applicator roller 66 is mounted on stub shafts 63A, 63B which are supported at opposite ends on a lower cradle assembly 100 formed by a pair of side support members 78, 80 which have sockets 79, 81 and retainer caps 101, 103. The stub shafts are received in roller bearings 105, 107 which permit free rotation of the applicator roller 66 about its longitudinal axis A1 (axis A2 in the upper cradle). The retainer caps 101, 103 hold the stub shafts 63A, 63B and bearings 105, 107 in the sockets 79, 81 and hold the applicator roller 66 in parallel alignment with the pivot axis X.

The side support members 74, 76 also have an upper cradle assembly 102 formed by a pair of side support members 82, 84 which are vertically spaced with respect to the lower side plates 78, 80. Each cradle 100, 102 has a pair of sockets 79, 81 and 83, 85, respectively, for holding an applicator roller 66, 67 for spot coating or inking engagement with the printing plate P the plate cylinder 32 (FIG. 4) or with a printing plate P or a blanket B on the blanket cylinder 34.

Preferably, the applicator roller 67 (FIG. 8, FIG. 9) the upper cradle (plate) position is an anilox roller having a resilient transfer surface. In the dual cradle arrangement as shown in FIG. 2, the press operator can quickly change from blanket inking/coating to plate inking/coating within minutes, since it is only necessary to release, remove and reposition or replace the applicator roller 66.

The capability to simultaneously print in the flexographic mode, the aqueous mode, the waterless mode, or the lithographic mode on different printing units of the same lithographic press and to print or coat from either the plate position or the blanket position on any one of the printing units is referred to herein as the LITHOFLEX™ printing process or system. LITHOFLEX™ is a trademark of Printing Research, Inc. of Dallas, Tex., U.S.A., exclusive licensee of the present invention.

Referring now to FIG. 14, an inking/coating apparatus 10 having an inking/coating assembly 109 of an alternative design is installed in the upper cradle position for applying ink and/or coating material to a plate P on the plate cylinder 32. According to this alternative embodiment, an applicator roller 67R having a resilient transfer surface is coupled to an anilox fluid metering roller which transfers measured amounts of printing ink or coating material to the plate P. The anilox roller 111 has a transfer surface constructed of metal, ceramic or composite material which is engraved with cells. The resilient applicator roller 67R is interposed in transfer engagement with the plate P and the metering surface of the anilox roller 111. The resilient transfer surface of the applicator roller 67R provides uniform, positive engagement with the plate.

Referring now to FIG. 17, an inking/coating apparatus 10 having an alternative inking/coating assembly 113 is installed in the lower cradle assembly 100 for applying flexographic or aqueous ink and/or coating material Q to a plate or blanket mounted on the blanket cylinder 34. Instead of using the sealed, dual doctor blade reservoir assembly 68 as shown in FIG. 6, an open, single doctor blade anilox roller assembly 113 is supplied with liquid ink Q or coating material contained in an open fountain pan 117. The liquid ink or coating material Q is transferred to the engraved transfer surface of the anilox roller 66 as it turns in the fountain pan 117. Excess ink or coating material Q is removed from the engraved transfer surface by a single doctor blade 68B. The liquid ink or coating material Q is pumped from an off-press source, for example the drum 73 shown in FIG. 17, through a supply conduit 119 into the fountain pan 117 by a pump 120.

For overall inking or coating jobs, the metering transfer surface of the anilox roller 66 extends over its entire peripheral surface. However, for certain printing jobs which print two or more separate images onto the same substrate, for example work and turn printing jobs, the metering transfer surface of the anilox applicator roller 66 is partitioned by a centrally located, annular undercut groove 66C which separates first and second metering transfer surfaces 66A, 66B as shown in FIG. 11 and FIG. 18.

The single doctor blade 68B has an edge 68E which wipes simultaneously against the split metering transfer surfaces 66A, 66B. In this single blade, split anilox roller embodiment 113, it is necessary to provide dual supply sources, for example drums 73A, 73B, dual supply lines 119A, 119B, and dual pumps 120A, 120B. Moreover, the fountain pan 117 is also split, and the pan 117 is divided into two pan sections 117A, 117B by a separator plate 121, as shown in FIG. 18. The separator plate 121 is centrally aligned with the undercut groove 66C, but does not touch the adjoining roller faces.

Although the single blade, split anilox applicator roller assembly 113 is shown mounted in the lower cradle position (FIG. 17), it should be understood that the single blade, split anilox applicator roller assembly 113 can be mounted and used in the upper cradle position, as well.

According to another aspect of the present invention, the inking/coating apparatus 10 is pivotally coupled on horizontal pivot pins 88P, 90P which allows the single head, dual cradle inking/coating apparatus 10 to be mounted on any lithographic printing unit. Referring to FIG. 9, the horizontal pivot pins 88P, 90P are mounted within the traditional dampener space 29 of the printing unit and are secured to the press side frames 14, 15, respectively. Preferably, the pivot support pins 88P, 90P are secured to the press side frames by a threaded fastener. The pivot support pins are received within circular openings 88, 90 which intersect the side support members 74, 76 of the inking/coating apparatus 10. The horizontal support pins 88P, 90P are disposed in parallel alignment with rotational axis X and with the plate cylinder and blanket cylinder, and are in longitudinal alignment with each other.

Preferably, the pivot pins 88P, 90P are located in the dampener space 29 so that the rotational axes A1, A2 of the applicator rollers 66, 67 are elevated with respect to the nip contact points N1, N2. By that arrangement, the transfer point between the applicator roller 66 and a blanket on the blanket cylinder 34 (as shown in FIG. 8) and the transfer

point between the applicator roller 66 and a plate on the plate cylinder 32 (as shown in FIG. 5) are above the radius lines R1, R2 of the plate cylinder and the blanket cylinder, respectively. This permits the inking/coating apparatus 10 to move clockwise to retract the applicator roller 66 to an off-impression position relative to the blanket cylinder in response to a single extension stroke of the power actuator arms 104A, 106A. Similarly, the applicator roller 66 is moved counterclockwise to the on-impression operative position as shown in FIGS. 4, 5, 6 and 8 by a single retraction stroke of the actuator arms 104A, 106A, respectively.

Preferably, the pivot pins are made of steel and the side support members are made of aluminum, with the steel pivot pins and the aluminum collar portion bordering the circular openings 88, 90 forming a low friction journal. By this arrangement, the inking/coating apparatus 10 is freely rotatable clockwise and counterclockwise with respect to the pivot pins 88P, 90P. Typically, the arc length of rotation is approximately 60 mils (about 1.5 mm). Consequently, the inking/coating apparatus 10 is almost totally enclosed within the dampener space 29 of the printing unit in the on-impression position and in the off-impression position.

The cradle assemblies 100 and 102 position the applicator roller 66 in inking/coating alignment with the plate cylinder or blanket cylinder, respectively, when the inking/coating apparatus 10 is extended to the operative (on-impression) position. Moreover, because the inking/coating apparatus 10 is installed within the dampener space 29, it is capable of freely rotating through a small arc while extending and retracting without being obstructed by the press side frames or other parts of the printing press. This makes it possible to install the inking/coating apparatus 10 on any lithographic printing unit. Moreover, because of its internal mounting position within the dampener space 29, the projection of the inking/coating apparatus 10 into the space between printing units is minimal. This assures unrestricted operator access to the printing unit when the applicator head is in the operative (on-impression) and retracted (off-impression) positions.

As shown in FIG. 4 and FIG. 5, movement of the inking/coating apparatus 10 is counterclockwise from the retracted (off-impression) position to the operative (on-impression) position.

Although the dampener side installation is preferred, the inking/coating apparatus 10 can be adapted for operation on the delivery side of the printing unit, with the inking/coating apparatus being movable from a retracted (off-impression) position to an on-impression position for engagement of the applicator roller with either a plate on the plate cylinder or a blanket on the blanket cylinder on the delivery side 25 of the printing unit.

Movement of the inking/coating apparatus 10 to the operative (on-impression) position is produced by power actuators, preferably double acting pneumatic cylinders 104, 106 which have extendable/retractable power transfer arms 104A, 106A, respectively. The first pneumatic cylinder 104 is pivotally coupled to the press frame 14 by a pivot pin 108, and the second pneumatic cylinder 106 is pivotally coupled to the press frame 15 by a pivot pin 110. In response to selective actuation of the pneumatic cylinders 104, 106, the power transfer arms 104A, 106A are extended or retracted. The power transfer arm 104A is pivotally coupled to the side support member 74 by a pivot pin 112. Likewise, the power transfer arm 106A is pivotally coupled to the side support member 76 by a pivot pin 114.

As the power arms extend, the inking/coating apparatus 10 is rotated clockwise on the pivot pins 88P, 90P, thus moving the applicator roller 66 to the off-impression position. As the power arms retract, the inking/coater apparatus 60 is rotated counterclockwise on the pivot pins 88P, 90P, thus moving the applicator roller 66 to the on-impression position. The torque applied by the pneumatic actuators is transmitted to the inking/coating apparatus 10 through the pivot pin 112 and pivot pin 114.

Fine adjustment of the on-impression position of the applicator roller relative to the plate cylinder or the blanket cylinder, and of the pressure of roller engagement, is provided by an adjustable stop assembly 115. The adjustable stop assembly 115 has a threaded bolt 116 which is engagable with a bell crank 118. The bell crank 118 is pivotally coupled to the side support member 74 on a pin 120. One end of the bell crank 118 is engagable by the threaded bolt 116, and a cam roller is mounted for rotation on its opposite end. The striking point of engagement is adjusted by rotation of the bolt 116 so that the applicator roller 66 is properly positioned for inking/coating engagement with the plate P or blanket B and provides the desired amount of inking/coating pressure when the inking/coating assembly 60 is moved to the operative position.

This arrangement permits the in-line inking/coating apparatus to operate effectively without encroaching in the interunit space between any adjacent printing units, and without blocking or obstructing access to the cylinders of the printing units when the inking/coating apparatus is in the extended (off-impression) position or retracted (on-impression) position. Moreover, when the in-line inking/coating apparatus is in the retracted position, the doctor blade reservoir and coating circulation lines can be drained and flushed automatically while the printing press is running as well as when the press has been stopped for change-over from one job to another or from one type of ink or coating to another.

Substrates which are printed or coated with aqueous flexographic printing inks require high velocity hot air for drying. When printing a flexographic ink such as opaque white or metallic gold, it is always necessary to dry the printed substrates between printing units before overprinting them. According to the present invention, the water component on the surface of the freshly printed or coated substrate S is evaporated and dried by high velocity, hot air interunit dryer and high volume heat and moisture extractor units 124, 126 and 128, as shown in FIG. 2, FIG. 4 and FIG. 5. The dryer/extractor units 124, 126 and 128 are oriented to direct high velocity heated air onto the freshly printed/coated substrates as they are transferred by the impression cylinder 36 and the intermediate transfer drum 40 of one printing unit and to another transfer cylinder 30 and to the impression cylinder 36 of the next printing unit. By that arrangement, the freshly printed flexographic ink or coating material is dried before the substrate S is overprinted by the next printing unit.

The high velocity, hot air dryer and high performance heat and moisture extractor units 124, 126 and 128 utilize high velocity air jets which scrub and break-up the moist air layer which clings to the surface of each freshly printed or coated sheet or web. Within each dryer, high velocity air is heated as it flows across a resistance heating element within an air delivery baffle tube. High velocity jets of hot air are discharged through multiple airflow apertures into an exposure zone Z (FIG. 4 and FIG. 5) and onto the freshly printed/coated sheet S as it is transferred by the impression cylinder 36 and transfer drum 40, respectively.

Each dryer assembly includes a pair of air delivery dryer heads 124D, 126D and 128D which are arranged in spaced,

side-by-side relationship. The high velocity, hot air dryer and high performance heat and moisture extractor units 124, 126 and 128 are preferably constructed as disclosed in co-pending U.S. patent application Ser. No. 08/132,584, filed Oct. 6, 1993, entitled "High Velocity Hot Air Dryer", to Howard W. DeMoore, co-inventor and assignee of the present invention, and which is incorporated herein by reference, and which is marketed by Printing Research, Inc. of Dallas, Tex., U.S.A., under its trademark SUPER BLUE HVTM.

The hot moisture-laden air displaced from the surface of each printed or coated sheet is extracted from the dryer exposure zone Z and exhausted from the printing unit by the high volume extractors 124, 126 and 128. Each extractor head includes an extractor manifold 124E, 126E and 128E coupled to the dryer heads 124D, 126D and 128D and draws the moisture, volatiles, odors and hot air through a longitudinal air gap G between the dryer heads. Best results are obtained when extraction is performed simultaneously with drying. Preferably, an extractor is closely coupled to the exposure zone Z at each dryer location as shown in FIG. 4. Extractor heads 124E, 126E and 128E are mounted on the dryer heads 124D, 126D and 128D, respectively, with the longitudinal extractor air gap G facing directly into the exposure zone Z. According to this arrangement, each printed or coated sheet is dried before it is printed on the next printing unit.

The aqueous water-based inks used in flexographic printing evaporate at a relatively moderate temperature provided by the interunit high velocity hot air dryers/extractors 124, 126 and 128. Sharpness and print quality are substantially improved since the flexographic ink or coating material is dried before it is overprinted on the next printing unit. Since the freshly printed flexographic ink is dry, dot gain is substantially reduced and back-trapping on the blanket of the next printing unit is virtually eliminated. This interunit drying/extracting arrangement makes it possible to print flexographic inks such as metallic ink and opaque white ink on the first printing unit, and then dry-trap and overprint on the second and subsequent printing units.

Moreover, this arrangement permits the first printing unit 22 to be used as a coater in which a flexographic, aqueous or UV-curable coating material is applied to the lowest grade substrate such as recycled paper, cardboard, plastic and the like, to trap and seal-in lint, dust, spray powder and other debris and provide a smoother, more durable printing surface which can be overprinted on the next printing unit.

A first down (primer) aqueous coating layer seals—in the surface of a low grade, rough substrate, for example, re-cycled paper or plastic, and improves overprinted dot definition and provides better ink lay-down while preventing strike-through and show-through. A flexographic UV-curable coating material can then be applied downstream over the primer coating, thus producing higher coating gloss.

Preferably, the applicator roller 66 is constructed of composite carbon fiber material, metal or ceramic coated metal when it is used for applying ink or coating material to the blanket B or other resilient material on the blanket cylinder 34. When the applicator roller 66 is applied to the plate, it is preferably constructed as an anilox roller having a resilient, compressible transfer surface. Suitable resilient roller surface materials include Buna N synthetic rubber and EPDM (terpolymer elastomer).

It has been demonstrated in prototype testing that the inking/coating apparatus 10 can apply a wide range of ink and coating types, including fluorescent (Day Glo), pearlescent, metallics (gold, silver and other metals), glitter, scratch and sniff (micro-encapsulated fragrance), scratch and reveal., luminous, pressure-sensitive adhesives and the like, as well as UV-curable and aqueous coatings.

With the dampener assembly removed from the printing unit, the inking/coating apparatus 10 can easily be installed in the dampener space for selectively applying flexographic inks and/or coatings to a flexographic or waterless printing plate or to the blanket. Moreover, overprinting of the flexographic inks and coatings can be performed on the next printing unit since the flexographic inks and/or coatings are dried by the high velocity, hot air interunit dryer and high volume heat and moisture extractor assembly of the present invention.

The flexographic inks and coatings as used in the present invention contain colored pigments and/or soluble dyes, binders which fix the pigments onto the surface of the substrate, waxes, defoamers, thickeners and solvents. Aqueous printing inks predominantly contain water as a diluent and/or vehicle. The thickeners which are preferred include algonates, starch, cellulose and its derivatives, for example cellulose esters or cellulose ethers and the like. Coloring agents including organic as well as inorganic pigments may be derived from dyes which are insoluble in water and solvents. Suitable binders include acrylates and/or polyvinylchloride.

When metallic inks are printed, the cells of the anilox roller must be appropriately sized to prevent the metal particles from getting stuck within the cells. For example, for metallic gold ink, the anilox roller should have a screen line count in the range of 175–300 lines per inch (68–118 lines per cm). Preferably, in order to keep the anilox roller cells clear, the doctor blade assembly 68 is equipped with a bristle brush BR (FIG. 14) as set forth in U.S. Pat. No. 5,425,809 to Steven M. Person, assigned to Howard W. DeMoore, and licensed to Printing Research, Inc. of Dallas, Tex., U.S.A., which is incorporated herein by reference.

The inking/coating apparatus 10 can also apply UV-curable inks and coatings. If UV-curable inks and coatings are utilized, ultra-violet dryers/extractors are installed adjacent to the high velocity hot air dryer/extractor units 124, 126 and 128, respectively.

It will be appreciated that the LITHOFLEXTM printing process described herein makes it possible to selectively operate a printing unit of a press in the lithographic printing mode while simultaneously operating another printing unit of the same press in either the flexographic printing mode or in the waterless printing mode, while also providing the capability to print or coat, separately or simultaneously, from either the plate position or the blanket position. The dual cradle support arrangement of the present invention makes it possible to quickly change over from inking/coating on the blanket cylinder position to inking/coating on the plate cylinder position with minimum press down-time, since it is only necessary to remove and reposition or replace the applicator roller 66 while the inking/coating apparatus 10 is in the retracted position. It is only necessary to remove four cap screws, lift the applicator roller 66 from the cradle, and reposition it in the other cradle. All of this can be accomplished in a few minutes, without removing the inking/coating apparatus 10 from the press.

It is possible to spot coat or overall coat from the plate position or from the blanket position with flexographic inks or coatings on one printing unit and then spot coat or overall coat with UV-curable inks or coatings from the plate posi-

tion or from the blanket position on another printing unit during the same press run. Moreover, the press operator can spot or overall coat from the plate for one job, and then spot and/or overall coat from the blanket on the next job.

The positioning of the applicator roller relative to the plate or blanket is repeatable to a predetermined preset operative position. Consequently, only minor printing unit modifications or alterations may be required for the LITHOFLEX™ process. Although automatic extension and retraction have been described in connection with the exemplary embodiment, extension to the operative (on-impression) position and retraction to a non-operative (off-impression) position can be carried out manually, if desired. In the manual embodiment, it is necessary to latch the inking/coating apparatus 10 to the press side frames 14, 15 in the operative (on-impression) position, and to mechanically prop the inking/coating apparatus in the off-impression (retracted) position.

Referring again to FIG. 8, an applicator roller 66 is mounted on the lower cradle assembly 100 by side support members 78, 80, and a second applicator roller 67 is mounted on the upper cradle assembly 102 by side support members 82, 84. According to this arrangement, the inking/coating apparatus 10 can apply printing ink and/or coating material to a plate on the plate cylinder, while simultaneously applying printing ink and/or coating material to a plate or a blanket on the blanket cylinder of the same printing unit. When the same color ink is used by the upper and lower applicator rollers from the plate position and from the blanket position simultaneously on the same printing unit, a "double bump" or double inking films or coating layers are applied to the substrate S during a single pass of the substrate through the printing unit. The tack of the two inks or coating materials must be compatible for good transfer during the double bump. Moreover, the inking/coating apparatus 10 can be used for supplying ink or coating material to the blanket cylinder of a rotary offset web press, or to the blanket of a dedicated coating unit.

According to conventional bronzing techniques, a metallic (bronze) powder is applied off-line to previously printed substrate which produces a grainy, textured finish or appearance. The on-line application of bronze material by conventional flexographic or lithographic printing will only produce a smooth, continuous appearance. However, a grainy, textured finish is preferred for highest quality printing which, prior to the present invention, could only be produced by off-line methods.

Referring now to FIG. 14 and FIG. 15, metallic ink or coating material is applied on-line to the substrate S by simultaneous operation of the upper and lower applicator rollers 67R, 66 to produce an uneven surface finish having a bronze-like textured or grainy appearance. According to the simulated bronzing method of the present invention, the flexographic bronze ink is applied simultaneously to the plate and to the blanket by the dual cradle inking/coating apparatus 10 as shown in FIG. 14. A resilient applicator roller 67R is mounted in the upper cradle 102, and an anilox applicator roller 66 is mounted on the lower cradle 100. The rollers are supplied from separate doctor blade reservoirs 70. The doctor blade reservoir 70 in the upper cradle position supplies bronze ink or coating material having relatively coarse, metallic particles 140 dispersed in aqueous or flexographic ink. The coarse particle ink or coating material is applied to the plate P by the resilient applicator roller 67R in the upper cradle position 102. At the same time, flexographic and/or bronze ink or coating material having relatively fine, metallic particles 142 is transferred to the blanket B by the anilox roller 66 which is mounted on the lower cradle 100.

The metering surfaces of the upper and lower applicator rollers have different cell sizes and volumetric capacities which accommodate the coarse and fine metallic particles. For example, the anilox roller 111 mounted in the upper cradle position 102 which transfers the coarse metallic particles 140 preferably has a screen line count in the range of 100–300 lines per inch (39–118 lines per cm), and the metering surface of the anilox roller 66 mounted on the lower cradle 100 which transfers the relatively fine metallic particles 142 preferably has a screen line count in the range of 200–600 lines per inch (79–236 lines per cm).

After transfer from the plate to the blanket, the fine metallic particles 142 form a layer over the coarse metallic particles 140. As both bronze layers are offset onto the substrate S, the layer of fine metallic particles 142 is printed onto the substrate S with the top layer of coarse metallic particles 140 providing a textured, grainy appearance. The fine metallic particles 142 cover the substrate which would otherwise be visible in the gaps between the coarse metallic particles 140. The combination of the coarse particle layer over the fine particle layer thus provides a textured, bronzed-like finish and appearance.

Particulate materials other than metal can be used for producing a textured finish. For example, coarse and fine particles of metallized plastic (glitter), mica particles (pearlescent) and the like, can be substituted for the metallic particles for producing unlimited surface variations, appearances and effects. All of the particulate material, including the metallic particles, are preferably in solid, flat platelet form, and have a size dimension suitable for application by an anilox applicator roller. Other particulate or granular material, for example stone grit having irregular form and size, can be used to good advantage.

Solid metal particles in platelet form, which are good reflectors of light, are preferred for producing the bronzed-like appearance and effect. However, various textured finishes, which could have light-reflective properties, can be produced by using granular materials such as stone grit. Most commonly used metals include copper, zinc and aluminum. Other ductile metals can be used, if desired. Moreover, the coarse and fine particles need not be made of the same particulate material. Various effects and textured appearances can be produced by utilizing diverse particulate materials for the coarse particles and the fine particles, respectively. Further, either fine or coarse particle ink or coating material can be printed from the upper cradle position, and either fine or coarse particle ink or coating material can be printed from the lower cradle position, depending on the special or surface finish that is desired.

It will be appreciated that the last printing unit 28 can be configured for additional inking/coating capabilities which include lithographic, waterless, aqueous and flexographic processes. Various substrate surface effects (for example double bump or triple bump inking/coating or bronzing) can be performed on the last printing unit. For triple bump inking/coating, the last printing unit 28 is equipped with an auxiliary in-line inking or coating apparatus 97 as shown in FIG. 3 and FIG. 4. The in-line inking or coating apparatus 97 allows the application of yet another film of ink or a protective or decorative layer of coating material over any freshly printed or coated surface effects or special treatments, thereby producing a triple bump. The triple bump is achieved by applying a third film of ink or layer of coating material over the freshly printed or coated double bump simultaneously while the substrate is on the impression cylinder of the last printing unit.

When the in-line inking/coating apparatus 97 is installed, it is necessary to remove the SUPER BLUE® flexible

covering from the delivery cylinder 42, and it is also necessary to modify or convert the delivery cylinder 42 for inking/coating service by mounting a plate or blanket B on the delivery cylinder 42, as shown in FIG. 3 and FIG. 4. Packing material is placed under the plate or blanket B, thereby packing the plate or blanket B at the correct packed-to-print radial clearance so that ink or coating material will be printed or coated onto the freshly printed substrate S as it transfers through the nip between the plate or blanket B on the converted delivery cylinder 42 and the last impression cylinder 36. According to this arrangement, a freshly printed or coated substrate is overprinted or overcoated with a third film or layer of ink or coating material simultaneously while a second film or layer of ink or coating material is being over-printed or over-coated on the last impression cylinder 36.

The auxiliary inking/coating apparatus 97 and the converted or modified delivery cylinder 42 are mounted on the delivery drive shaft 43. The inking/coating apparatus 97 includes an applicator roller, preferably an anilox applicator roller 97A, for supplying ink or coating material to a plate or blanket B on the modified or converted delivery cylinder 42. The in-line inking/coating apparatus 97 and the modified or converted delivery cylinder 42 are preferably constructed as described in U.S. Pat. No. 5,176,077 to Howard W. DeMoore (co-inventor and assignee), which is hereby incorporated by reference. The in-line inking/coating apparatus 97 is manufactured and sold by Printing Research, Inc. of Dallas, Tex., U.S.A., under its trademark SUPER BLUE EZ COATER™.

After the delivery cylinder 42 has been modified or converted for inking/coating service, and because of the reduced nip clearance imposed by the plate or blanket B, the modified delivery cylinder 42 can no longer perform its original function of guiding and transferring the freshly printed or coated substrate. Instead, the modified or converted delivery cylinder 42 functions as a part of the inking/coating apparatus 97 by printing or coating a third down film of ink or layer of coating material onto the freshly printed or coated substrate as it is simultaneously printed or coated on the last impression cylinder 36. Moreover, the mutual tack between the second down ink film or coating layer and the third down ink film or coating layer causes the overprinted or overcoated substrate to cling to the plate or blanket, thus opposing or resisting separation of the substrate from the plate or blanket.

To remedy this problem, a vacuum-assisted transfer apparatus 99 is mounted adjacent the modified or converted delivery cylinder 42 as shown in FIG. 3 and FIG. 4. Another purpose of the vacuum-assisted transfer apparatus 99 is to separate the freshly overprinted or overcoated triple bump substrate from the plate or blanket B as the substrate transfers through the nip. The vacuum-assisted transfer apparatus 99 produces a pressure differential across the freshly overprinted or overcoated substrate as it transfers through the nip, thus producing a separation force onto the substrate and providing a clean separation from the plate or blanket B.

The vacuum-assisted transfer apparatus 99 is preferably constructed as described in U.S. Pat. Nos. 5,113,255; 5,127,329; 5,205,217; 5,228,391; 5,243,909; and 5,419,254, all to Howard W. DeMoore, co-inventor, which are incorporated herein by reference. The vacuum-assisted transfer apparatus 99 is manufactured and sold by Printing Research, Inc. of Dallas, Tex., U.S.A. under its trademark BACVAC®.

Although the present invention and its advantages have been described in detail, it should be understood that various

changes, substitutions and alterations can be made herein without departing from the spirit and scope of the present invention as defined by the appended claims.

What is claimed is:

1. A method for printing in a rotary offset press of the type including first and second printing units, the first printing unit having a flexographic printing plate, a blanket, an impression cylinder and inking/coating applicator means for applying aqueous or flexographic printing ink or coating material to the flexographic printing plate and/or to the blanket, comprising the following steps performed in succession in the first printing unit:

applying a first spot or overall coating of aqueous or flexographic printing ink or coating material to the flexographic printing plate;

transferring the aqueous or flexographic printing ink or coating material from the flexographic printing plate to the blanket;

applying a second spot or overall film of aqueous or flexographic printing ink or layer of coating material to the blanket;

transferring ink or coating material from the blanket to a substrate as the substrate is transferred through the nip between the blanket and the impression cylinder; and,

drying the aqueous or flexographic ink or coating material on the freshly printed or coated substrate before the substrate is printed, coated or otherwise processed on the second printing unit.

2. The printing method as defined in claim 1, including the steps:

applying a primer coating of an aqueous or flexographic ink or coating material to a substrate in the first printing unit;

trapping and sealing particulate material such as dust, lint, anti-offset spray powder and the like under the primer coating;

drying the primer coating on the substrate before the substrate is printed or coated on the second printing unit; and,

overprinting the freshly coated substrate in the second printing unit.

3. The printing method as defined in claim 1,

wherein the drying step is performed by directing heated air onto the freshly printed or coated substrate while the freshly printed or coated substrate is in contact with the impression cylinder of the first printing unit.

4. The printing method as defined in claim 1, including the steps:

transferring the freshly printed or coated substrate to an intermediate transfer cylinder disposed between the first and second printing units; and,

drying the freshly printed or coated substrate while said substrate is in contact with the intermediate transfer cylinder.

5. The printing method as defined in claim 1, wherein:

the drying step is performed by directing heated air onto the freshly printed or coated substrate while the freshly printed or coated substrate is in contact with an impression cylinder in the second printing unit.

6. The printing method as defined in claim 1, wherein the drying step is performed by directing heated air from a dryer onto the freshly printed or coated substrate, and including the step:

extracting hot air, moisture and volatiles from an exposure zone between the freshly printed or coated substrate

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and the dryer while the freshly printed or coated substrate is in contact with the impression cylinder of the first printing unit.

7. The printing method as defined in claim 1, including the steps:

transferring the freshly printed or coated substrate to an intermediate transfer cylinder disposed between the first and second printing units;

directing heated air from a dryer onto the freshly printed or coated substrate while said substrate is in contact with the intermediate transfer cylinder; and,

extracting hot air, moisture and volatiles from an exposure zone between the freshly printed or coated substrate and said dryer while the freshly printed or coated substrate is in contact with the intermediate transfer cylinder.

8. The printing method as defined in claim 1, including the steps:

transferring the freshly printed or coated substrate to an impression cylinder on the second printing unit;

directing heated air from a dryer onto the freshly printed or coated substrate while said substrate is in contact with the impression cylinder of the second printing unit; and,

extracting hot air, moisture and volatiles from an exposure zone between the freshly printed or coated substrate and said dryer while said substrate is in contact with the impression cylinder of the second printing unit.

9. A method for providing an uneven printed or coated layer on a substrate in a rotary offset printing press of the type including a printing unit having a plate cylinder, a flexographic printing plate mounted on the plate cylinder, a blanket cylinder, a plate or blanket mounted on the blanket cylinder, an impression cylinder and applicator means for applying aqueous or flexographic printing ink or coating material to the flexographic printing plate and/or to the plate or blanket on the blanket cylinder, comprising the following steps performed in succession in the printing unit:

applying a first down layer of aqueous or flexographic ink or coating material containing relatively coarse particles to the flexographic plate;

transferring the relatively coarse particle printing ink or coating material from the flexographic printing plate to the plate or blanket on the blanket cylinder;

applying a second down layer of aqueous or flexographic printing ink or coating material containing relatively fine particles onto the relatively coarse particle printing ink or coating material;

transferring the coarse and fine particle ink or coating material from the blanket or plate on the blanket cylinder onto a substrate as the substrate is transferred through the nip between the blanket cylinder and the impression cylinder; and,

drying the freshly printed or coated substrate before the freshly printed or coated substrate is subsequently printed, coated or otherwise processed.

10. The method as set forth in claim 9, wherein the coarse and fine particles comprise a metal selected from the group including copper, zinc and aluminum.

11. The method as set forth in claim 9, wherein the coarse and fine particles comprise a non-metallic material selected from the group consisting of mica, silicon, stone grit and plastic.

12. The method as set forth in claim 9, wherein the coarse and fine particles comprise diverse particulate materials, respectively.

13. A method for printing or coating a substrate on the last printing unit of a rotary offset printing press of the type including a plate cylinder, a printing plate mounted on the plate cylinder, a blanket cylinder, a plate or blanket mounted on the blanket cylinder, an impression cylinder, inking/coating apparatus for applying printing ink or coating material simultaneously or separately to the flexographic printing plate and/or to the plate or blanket on the blanket cylinder, and including an inking/coating cylinder mounted adjacent the last printing unit for printing a film of ink or layer of coating material over a freshly printed substrate, comprising the steps:

applying a first down film of printing ink or layer of coating material to the printing plate;

transferring printing ink or coating material from the printing plate to a plate or blanket on the blanket cylinder;

applying a second down film of printing ink or layer of coating material over the first down film or layer on the plate or blanket on the blanket cylinder;

transferring ink or coating material from the blanket or plate on the blanket cylinder onto a substrate as the substrate is transferred through the nip between the blanket cylinder and the impression cylinder; and

simultaneously printing a third down film of printing ink or layer of coating material over the second down film of ink or layer of coating material while the second down film or layer is being printed or coated on the last impression cylinder.

14. A method for printing or coating a substrate in a rotary offset printing press of the type including a printing unit having a plate cylinder, a flexographic printing plate mounted on the plate cylinder, a blanket cylinder, a plate or blanket mounted on the blanket cylinder, an impression cylinder, and inking/coating apparatus for applying flexographic or aqueous printing ink or coating material to the flexographic printing plate and/or to the plate or blanket on the blanket cylinder, comprising the following steps:

applying a first down film or layer of flexographic or aqueous printing ink or coating material to the flexographic printing plate;

transferring printing ink or coating material from the flexographic printing plate to the plate or blanket on the blanket cylinder;

applying a second down film or layer of aqueous or flexographic printing ink or coating material over the first dowel film or layer on the plate or blanket on the blanket cylinder;

transferring ink or coating material from the blanket or plate on the blanket cylinder onto a substrate as the substrate is transferred through the nip between the blanket cylinder and the impression cylinder; and,

drying the freshly printed or coated substrate before the substrate is subsequently printed, coated or otherwise processed.

15. A method of printing or coating a substrate in a rotary offset printing press as set forth in claim 14, wherein the printing unit is the last printing unit of the rotary offset printing press and a delivery cylinder is mounted on the last printing unit for transferring the freshly printed substrate along a substrate travel path, including the steps:

modifying the delivery cylinder by mounting a plate or blanket on the delivery cylinder;

transferring ink or coating material to the plate or blanket on the modified delivery cylinder; and

transferring a third down film or layer of aqueous or flexographic printing ink or coating material from the plate or blanket over the second down film or layer simultaneously while the freshly printed or coated substrate is on the last impression cylinder of the last printing unit.

16. A method for rotary offset printing as defined in any one of claims 1, 9, 13 or 14, including the steps:

circulating liquid ink or coating material from a supply container to said inking/coating applicator means and from said inking/coating applicator means to the supply container; and,

heating or cooling the liquid ink or coating material as it is circulated.

* * * * *

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US005960713A

United States Patent [19]
DeMoore et al.

[11] **Patent Number:** 5,960,713
[45] **Date of Patent:** Oct. 5, 1999

[54] **RETRACTABLE PRINTING-COATING UNIT OPERABLE ON THE PLATE AND BLANKET CYLINDERS SIMULTANEOUSLY FROM THE DAMPENER SIDE OF THE FIRST PRINTING UNIT OR ANY CONSECUTIVE PRINTING UNIT OR ANY ROTARY OFFSET PRINTING PRESS**

[75] Inventors: **Howard W. DeMoore**, 10954 Shady Trail, Dallas, Tex. 75220; **Ronald M. Rendleman**, Dallas, Tex.; **John W. Bird**, Carrollton, Tex.

[73] Assignee: **Howard W. DeMoore**, Dallas, Tex.

[21] Appl. No.: **09/136,901**

[22] Filed: **Aug. 19, 1998**

Related U.S. Application Data

[63] Continuation-in-part of application No. 08/538,472, Oct. 2, 1995, abandoned, which is a continuation-in-part of application No. 08/435,798, May 4, 1995.

[51] **Int. Cl.**[6] **B41F 7/06**; B41F 5/02; B41F 5/22

[52] **U.S. Cl.** **101/137**; 101/177

[58] **Field of Search** 101/136, 137, 101/142, 143, 144, 145, 177, 183, 207–210, 216, 217, 218, 349.1, 350.1, 350.2, 351.3, 352.01, 352.02, 352.04, 352.05, 363

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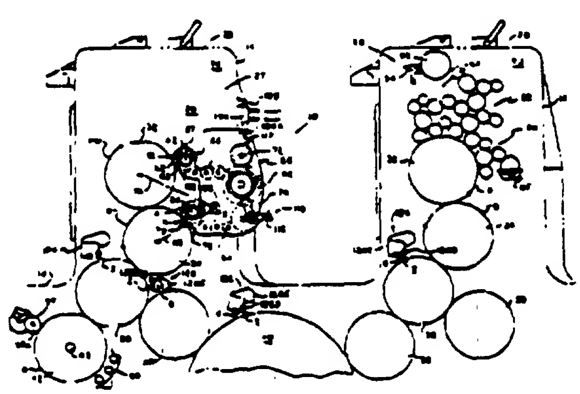
Primary Examiner—J. Reed Fisher
Attorney, Agent, or Firm—Locke Liddell & Sapp LLP

[57] **ABSTRACT**

A retractable in-line inking/coating apparatus can apply either spot or overall inking/coating material to a plate and/or a blanket on the first printing unit or on any consecutive printing unit of any rotary offset printing press. The inking/coating apparatus is pivotally mounted within the conventional dampener space of any lithographic printing unit. The aqueous component of the flexographic printing ink or aqueous coating material is evaporated and dried by high velocity, hot air dryers and high performance heat and moisture extractors so that the aqueous or flexographic ink or coating material on a freshly printed or coated sheet is dry and can be dry-trapped on the next printing unit. The inking/coating apparatus includes dual cradles that support first and second applicator rollers so that the inking/coating apparatus can apply a double bump of aqueous/flexographic or UV-curable printing ink or coating material to a plate on the plate cylinder, while simultaneously applying aqueous, flexographic or UV-curable printing ink or coating material to a plate or a blanket on the blanket cylinder, and thereafter onto a sheet as the sheet is transferred through the nip between the blanket cylinder and the impression cylinder. A triple bump is printed or coated on the last printing unit with the aid of an impression cylinder inking/coating unit.

26 Claims, 15 Drawing Sheets



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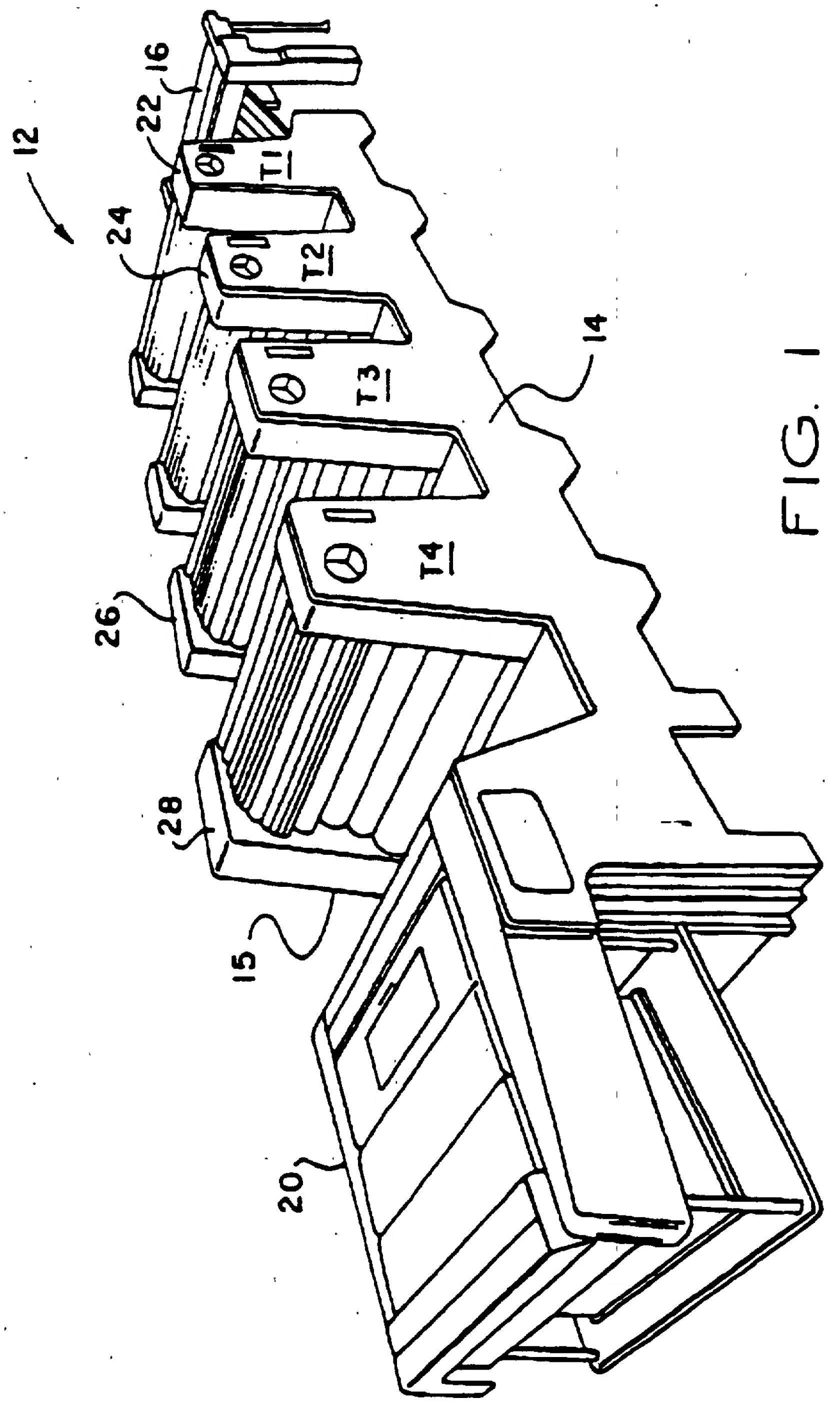

FIG. 1

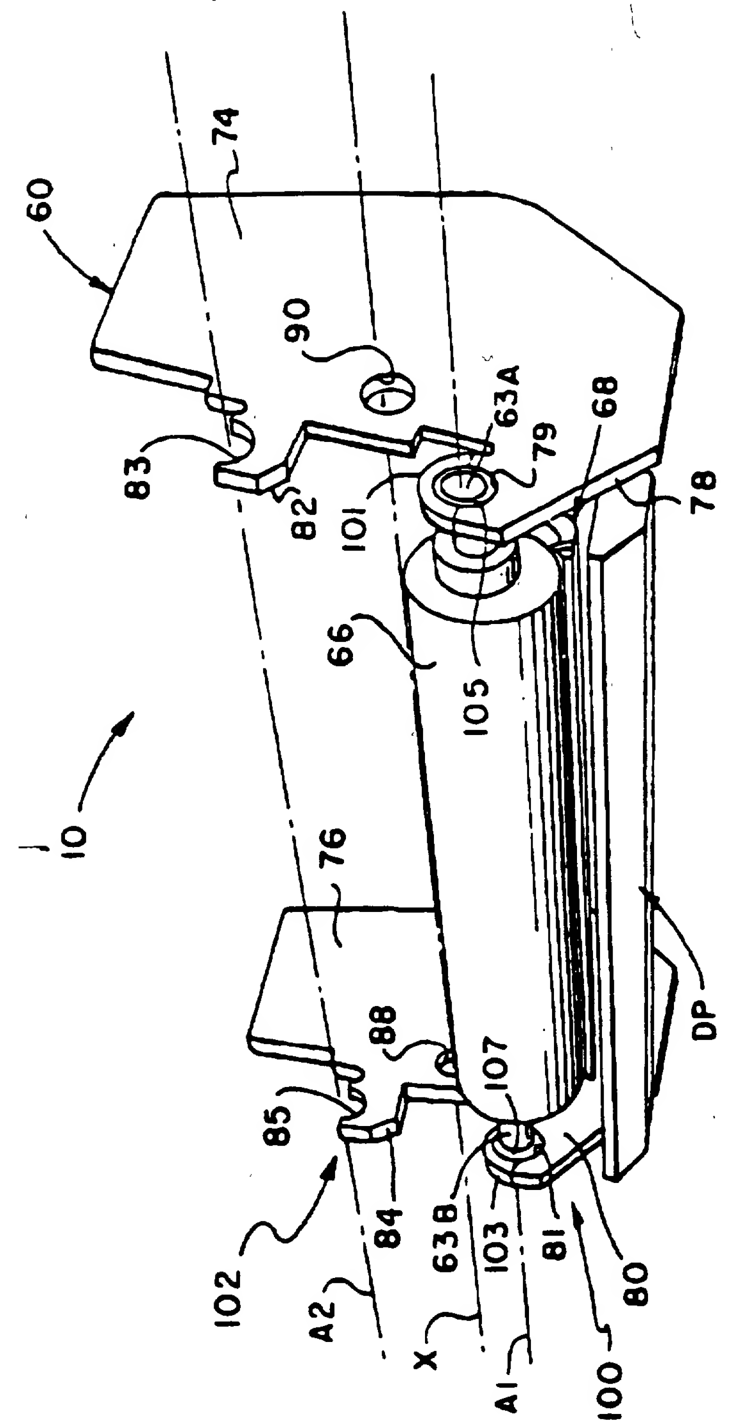
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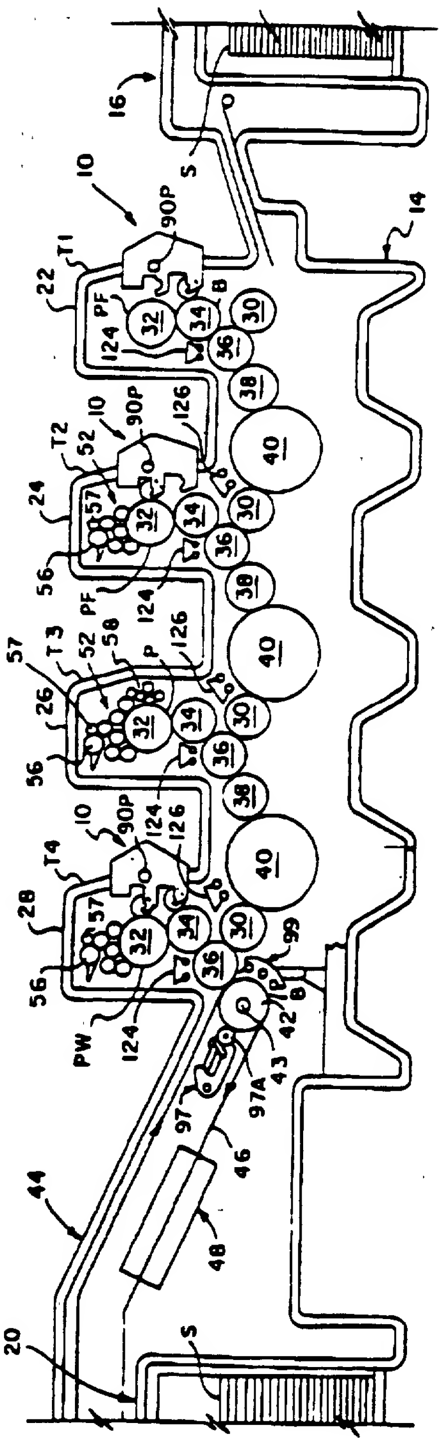
FIG. 2



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S
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FIG. 3

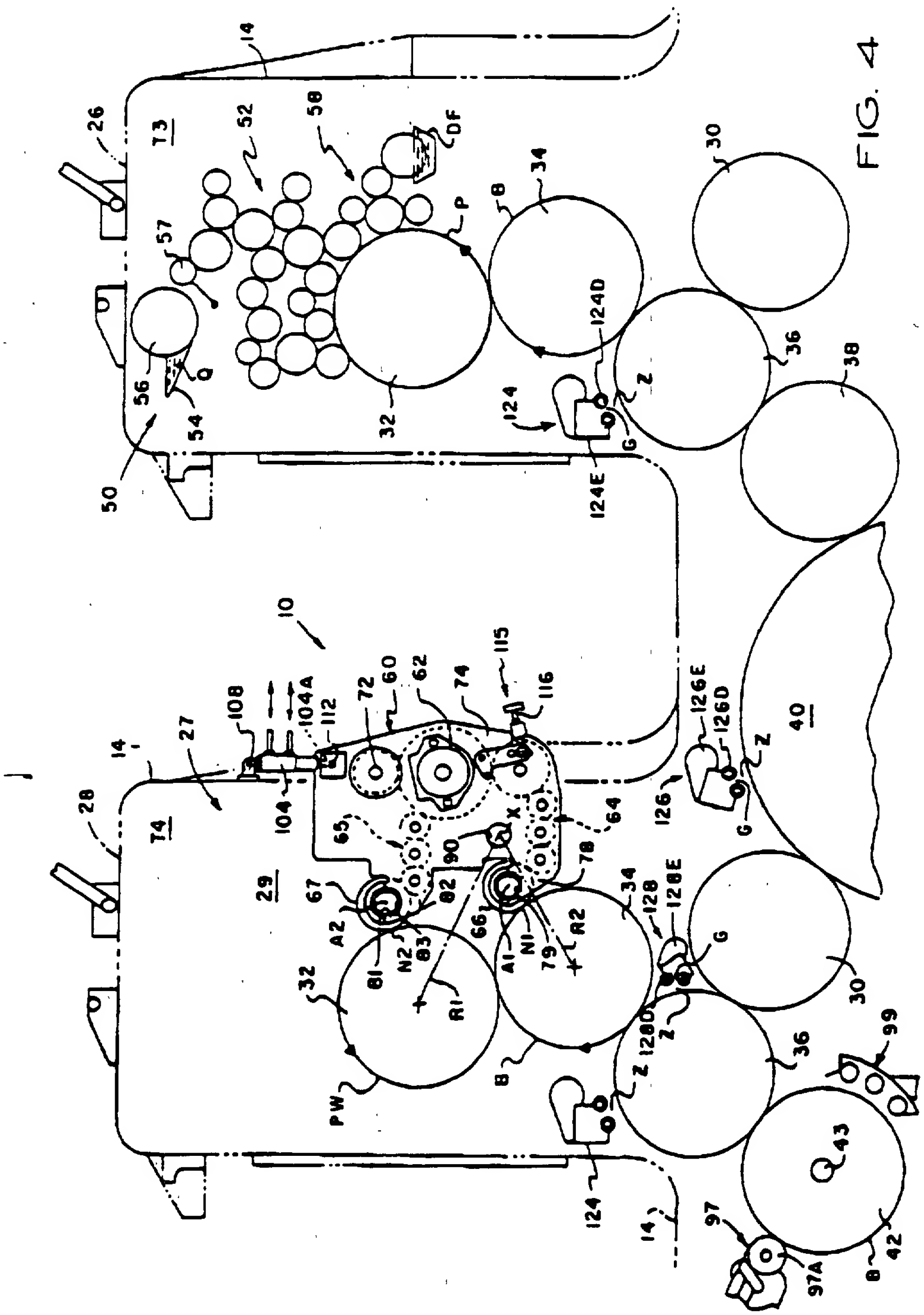


FIG. 4

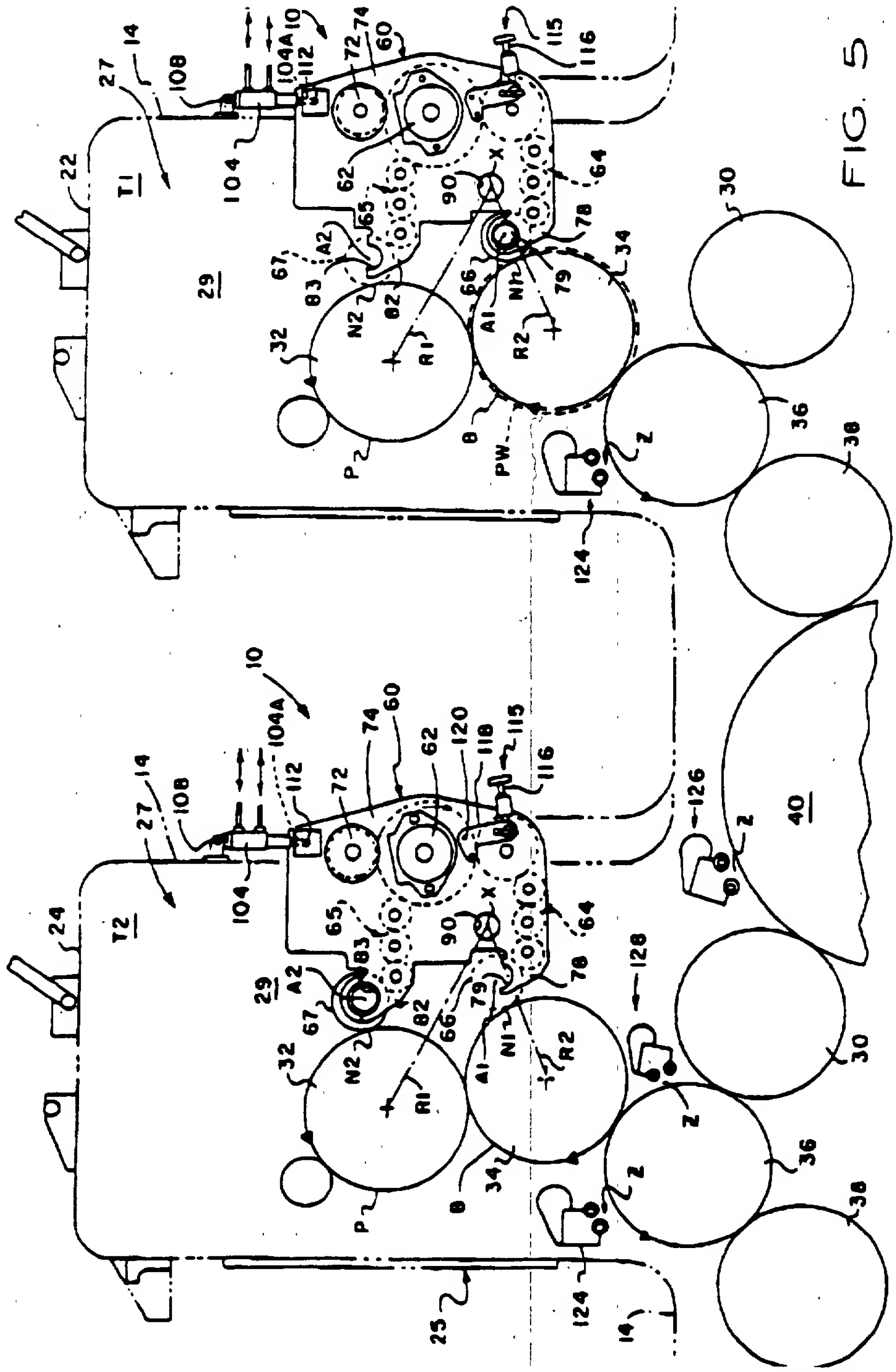
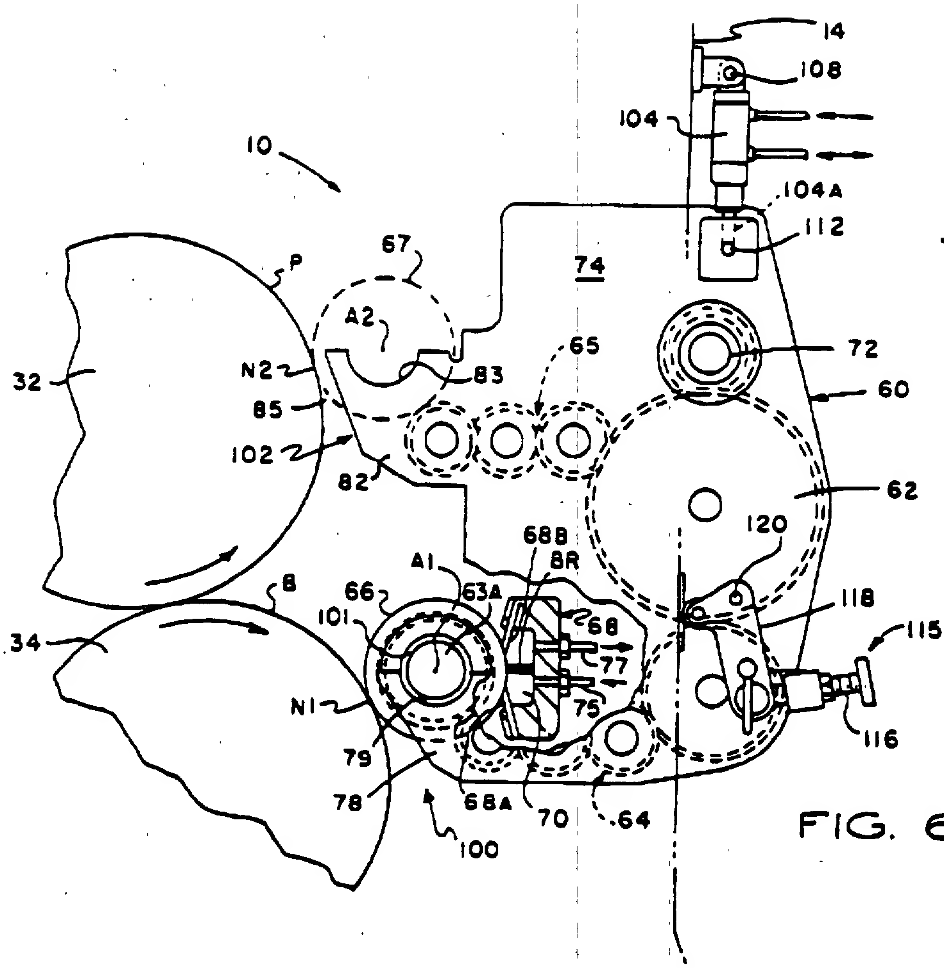


FIG. 5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112
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N2
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68B
BR
120
A1
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FIG. 6

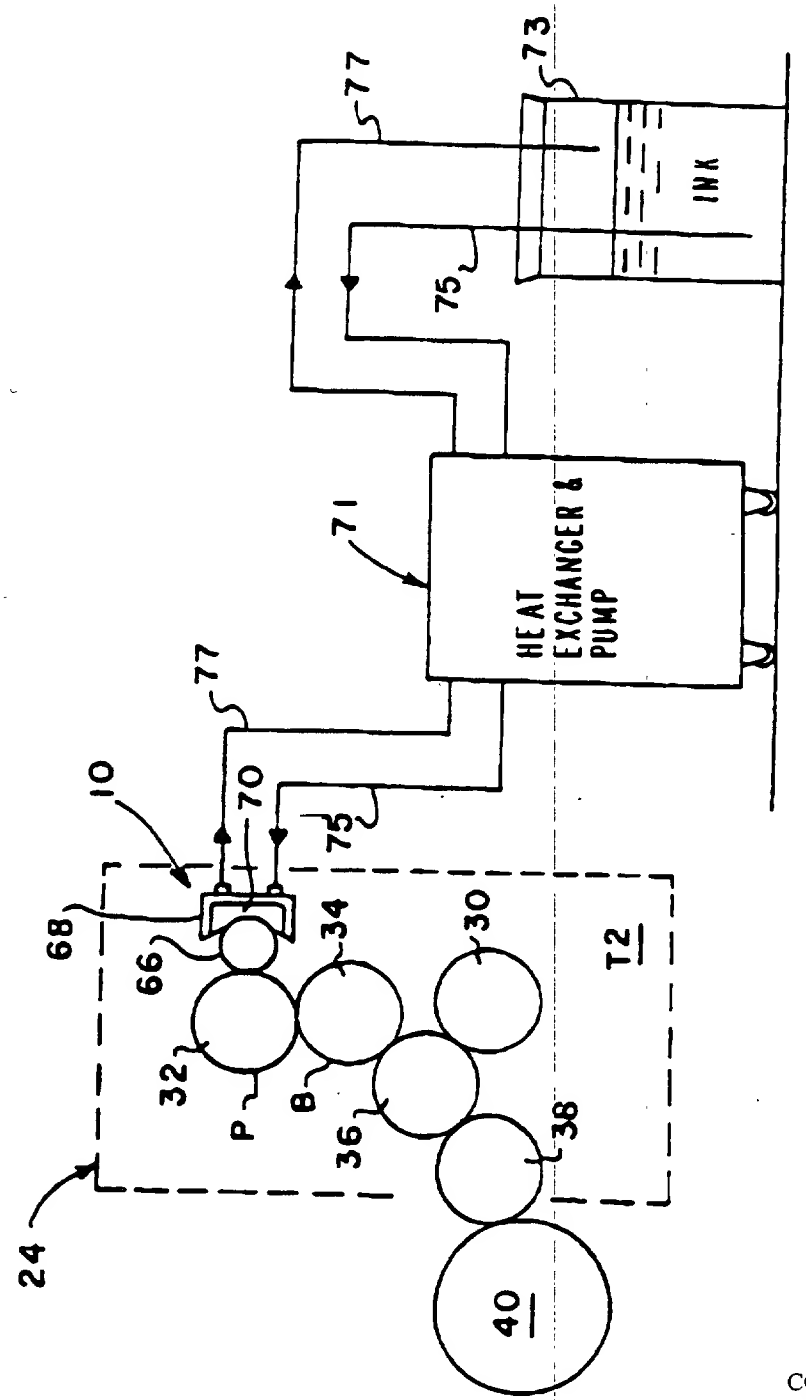
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FIG. 7

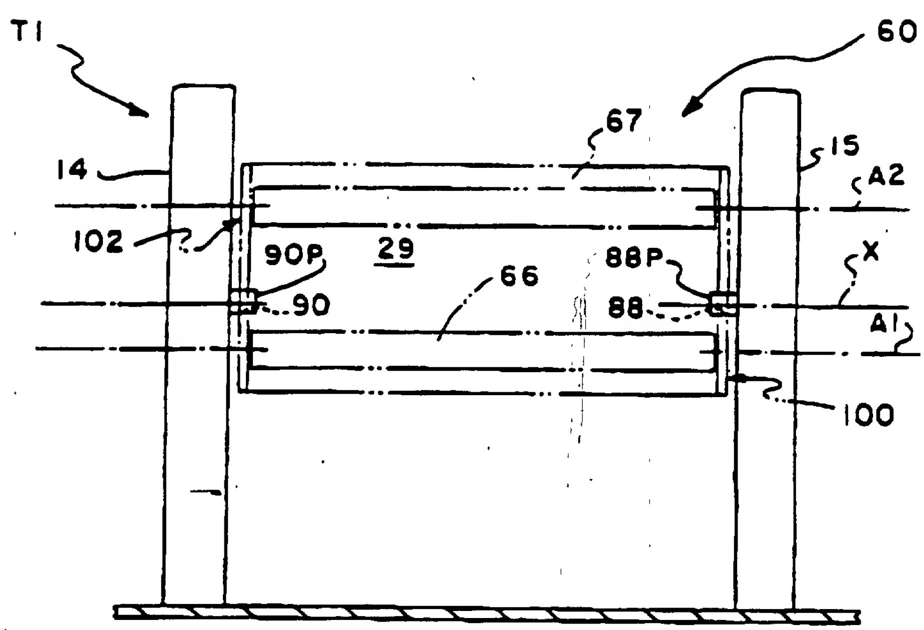
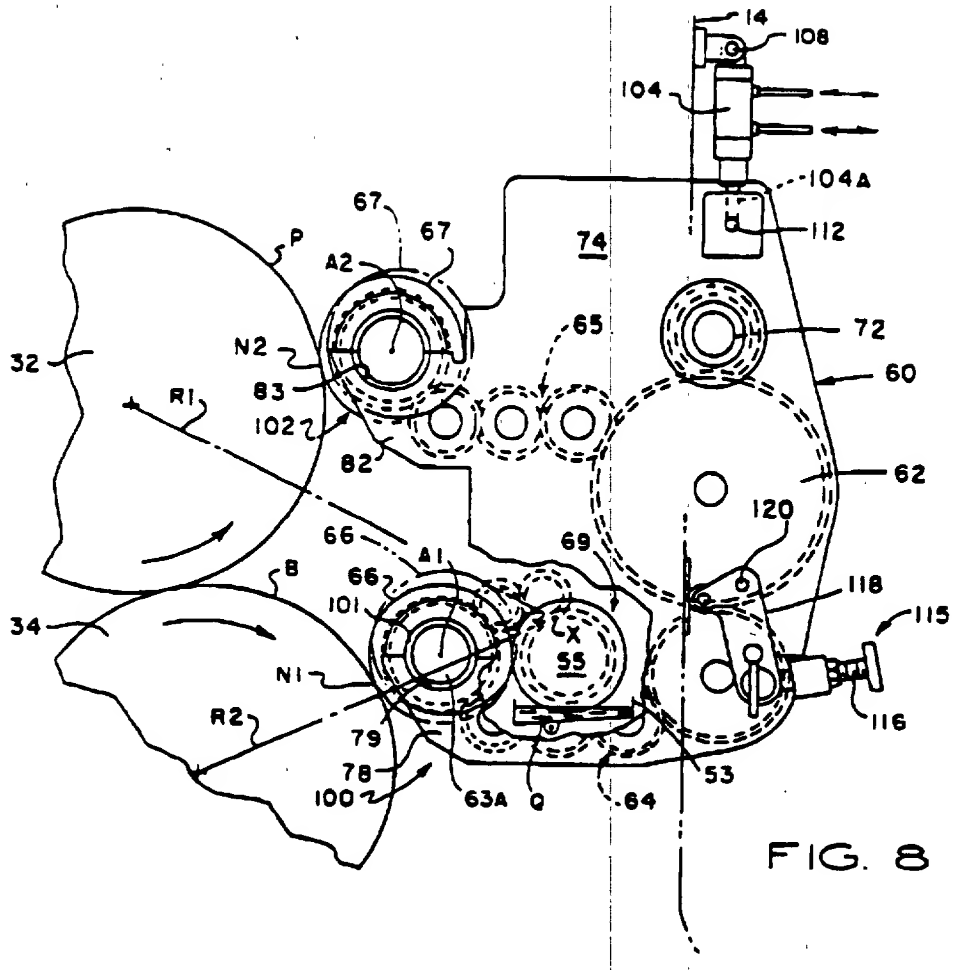


FIG. 9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A1
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FIG. 8

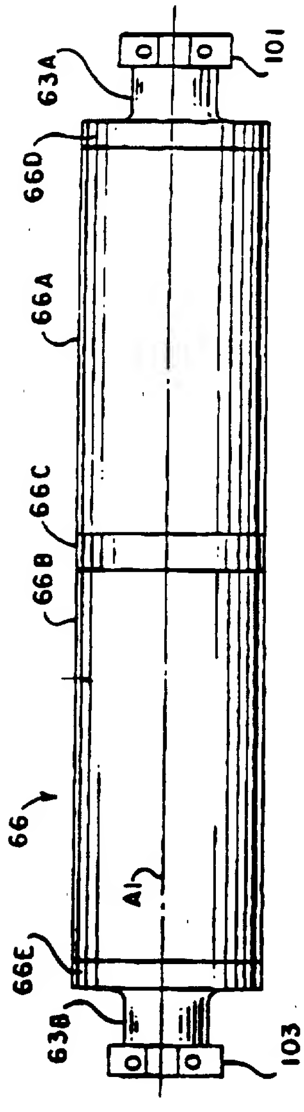

FIG. 11

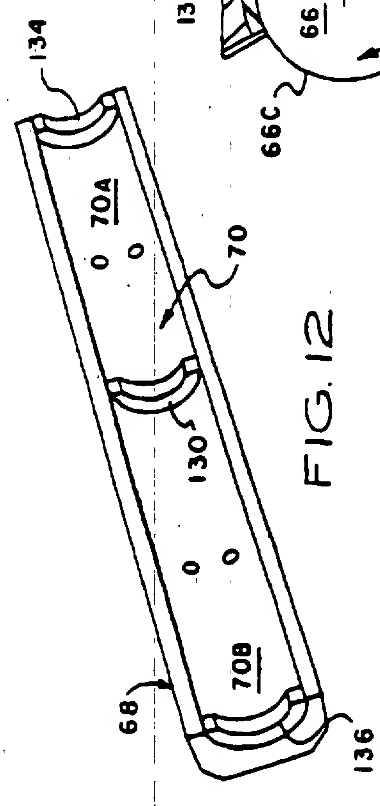

FIG. 12

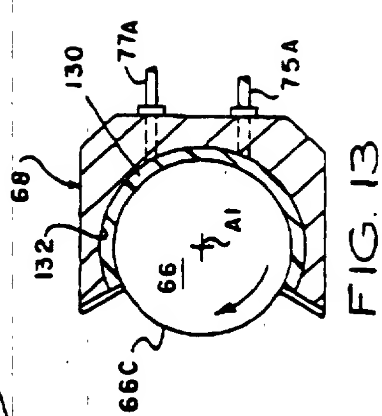

FIG. 13

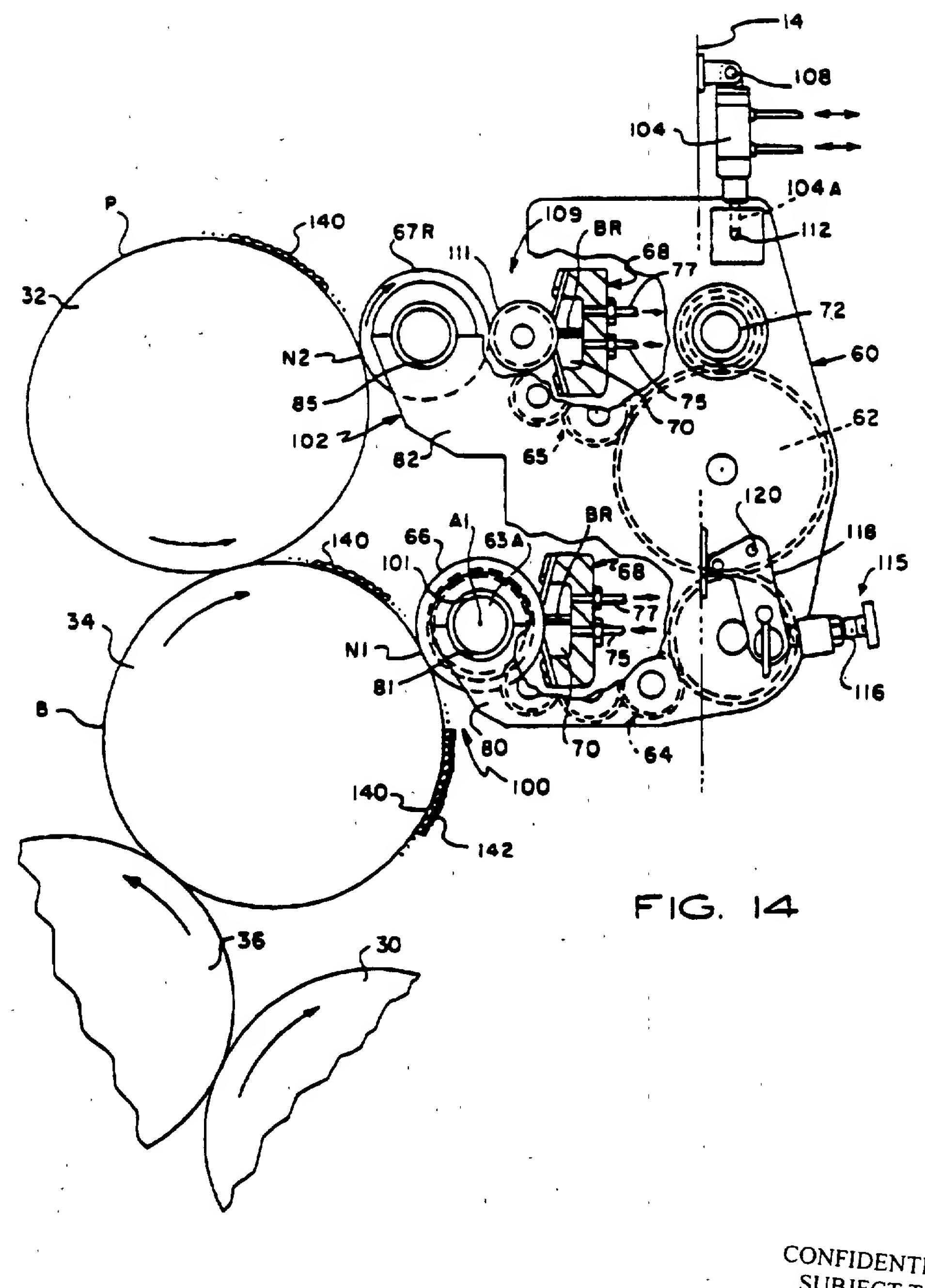
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FIG. 14

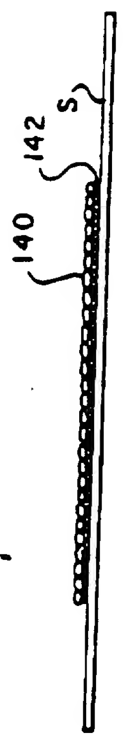


FIG. 15

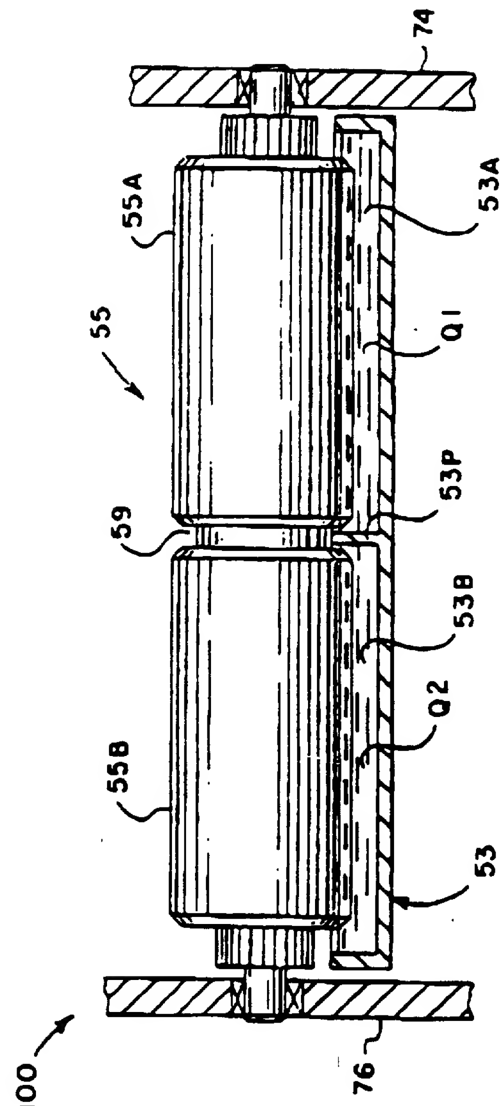
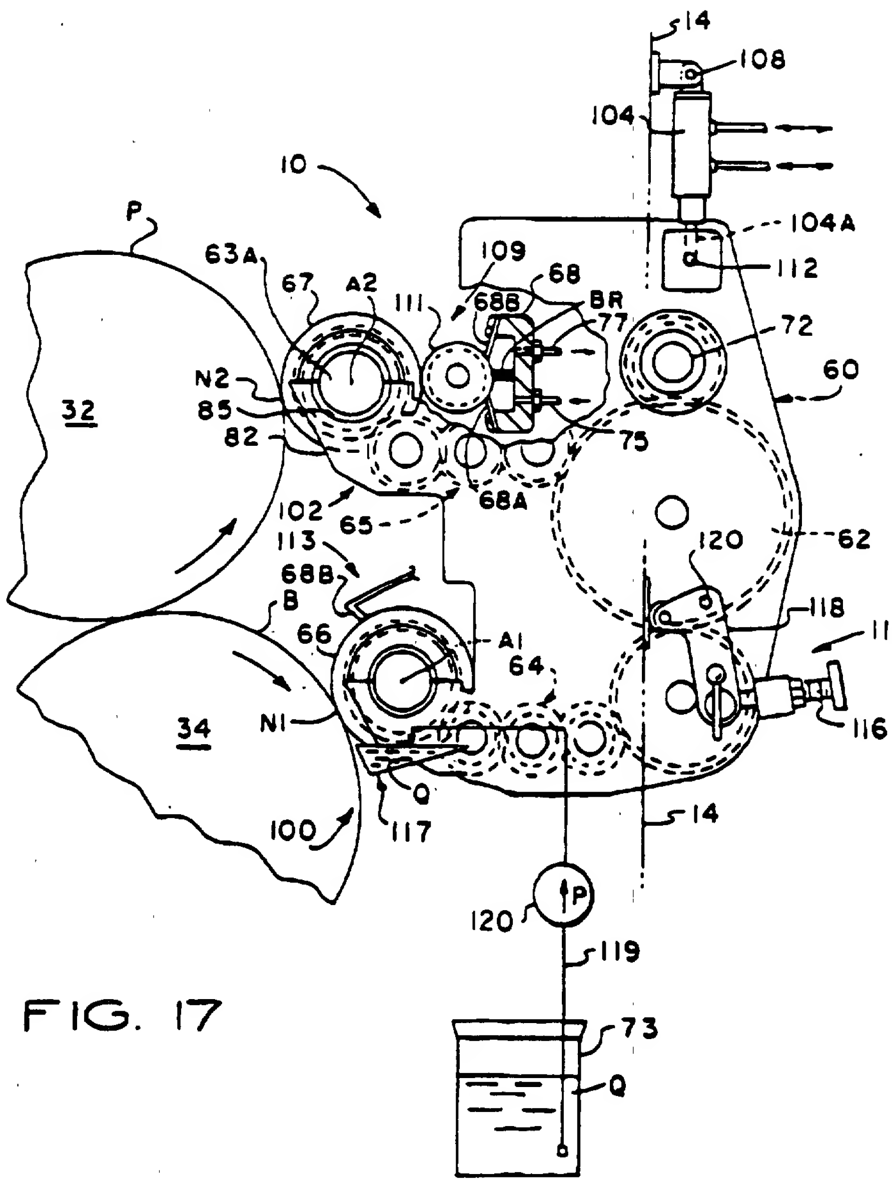


FIG. 16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68B
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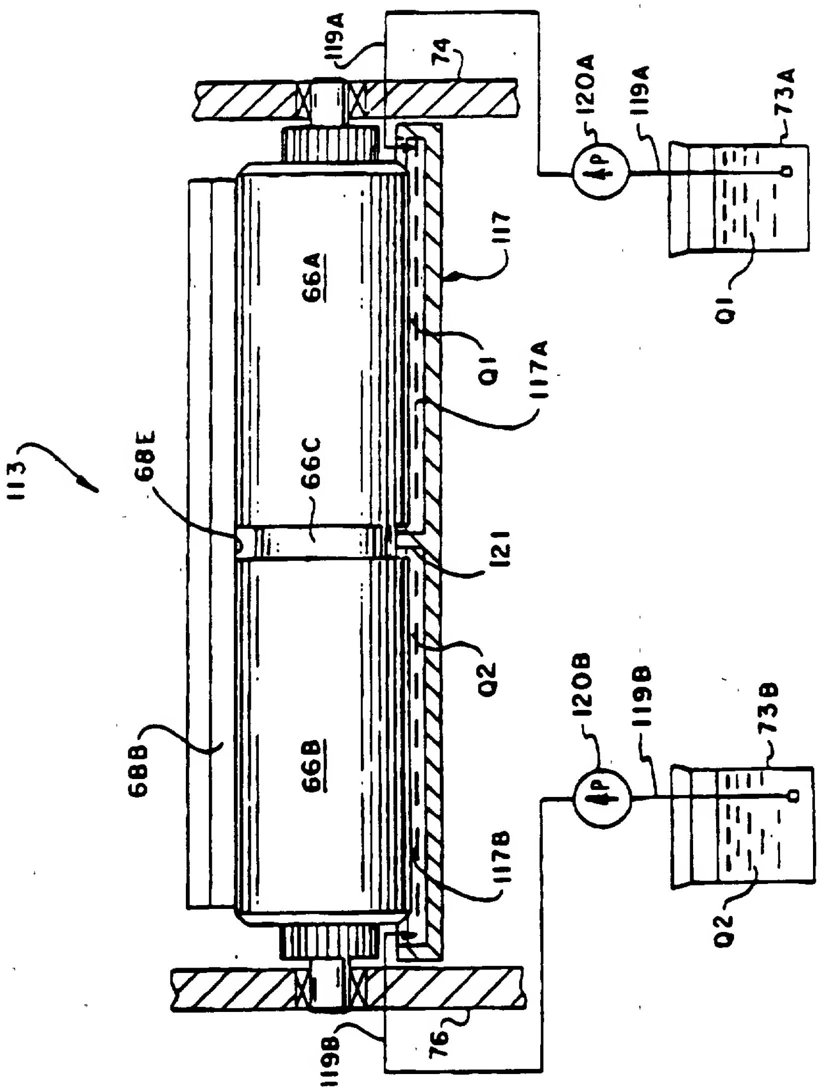
Q

FIG. 17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73B
68B
66B
117B
Q2
76
119B

FIG. 18

RETRACTABLE PRINTING-COATING UNIT OPERABLE ON THE PLATE AND BLANKET CYLINDERS SIMULTANEOUSLY FROM THE DAMPENER SIDE OF THE FIRST PRINTING UNIT OR ANY CONSECUTIVE PRINTING UNIT OR ANY ROTARY OFFSET PRINTING PRESS

CROSS REFERENCE TO OTHER APPLICATIONS

This application is a continuation-in-part of prior application Ser. No. 08/538,422 filed Oct. 2, 1995, now abandoned by inventors Howard W. DeMoore, Ronald M. Rendleman and John W. Bird which in turn was a continuation-in-part of prior parent application Ser. No. 08/435,798, titled "Retractable Inking/Coating Apparatus Having Ferris Movement Between Printing Units", filed May 4, 1995 by the same inventors for which priority benefit under § 120 is claimed.

FIELD OF THE INVENTION

This invention relates generally to sheet-fed or web-fed, rotary offset lithographic printing presses, and more particularly, to a new and improved inking/coating apparatus for the in-line application of aqueous or flexographic printing inks, primer or protective/decorative coatings applied simultaneously to the plate and blanket of the first or any consecutive printing unit of any lithographic printing press.

BACKGROUND OF THE INVENTION

Conventional sheet-fed, rotary offset printing presses typically include one or more printing units through which individual sheets are fed and printed. After the last printing unit, freshly printed sheets are transferred by a delivery conveyor to the delivery end of the press where the freshly printed and/or coated sheets are collected and stacked uniformly. In a typical sheet-fed, rotary offset printing press such as the Heidelberg Speedmaster line of presses, the delivery conveyor includes a pair of endless chains carrying gripper bars with gripper fingers which grip and pull freshly printed sheets from the last impression cylinder and convey the sheets to the sheet delivery stacker.

Since the inks used with sheet fed rotary offset printing presses are typically wet and tacky, special precautions must be taken to prevent marking and smearing of the freshly printed or coated sheets as the sheets are transferred from one printing unit to another. The printed ink on the surface of the sheet dries relatively slowly and is easily smeared during subsequent transfer between printing units. Marking, smearing and smudging can be prevented by a vacuum assisted sheet transfer apparatus as described in the following U.S. Pat. Nos: 5,113,255; 5,127,329; 5,205,217; 5,228,391; 5,243,909; and 5,419,254, all to Howard W. DeMoore, co-inventor, and manufactured and sold by Printing Research, Inc. of Dallas, Tex., U.S.A. under its trademark BACVAC™.

In some printing jobs, offsetting is prevented by applying a protective and/or decorative coating material over all or a portion of the freshly printed sheets. Some coatings are formed of a UV-curable or water-dispersed resin applied as a liquid solution over the freshly printed sheets to protect the ink from offsetting or set-off and improve the appearance of the freshly printed sheets. Such coatings are particularly desirable when decorative or protective finishes are applied in the printing of posters, record jackets, brochures, magazines, folding cartons and the like.

DESCRIPTION OF THE PRIOR ART

Various arrangements have been made for applying the coating as an in-line printing operation by using the last printing unit of the press as the coating application unit. For example, U.S. Pat. Nos. 4,270,483; 4,685,414; and 4,779,557 disclose coating apparatus which can be moved into position to permit the blanket cylinder of the last printing unit of a printing press to be used to apply a coating material over the freshly printed sheets. In U.S. Pat. No. 4,841,903 (Bird) there are disclosed coating apparatus which can be selectively moved between the plate cylinder or the blanket cylinder of the last printing unit of the press so the last printing unit can only be used for coating purposes. However, when coating apparatus of these types are being used, the last printing unit cannot be used to print ink to the sheets, but rather can only be used for the coating operation. Thus, while coating with this type of in-line coating apparatus, the printing press loses the capability of printing on the last printing unit as it is converted to a coating unit.

The coater of U.S. Pat. No. 5,107,790 (Sliker et al) is retractable along an inclined rail for extending and retracting a coater head into engagement with a blanket on the blanket cylinder. Because of its size, the rail-retractable coater can only be installed between the last printing unit of the press and the delivery sheet stacker, and cannot be used for interunit coating. The coater of U.S. Pat. No. 4,615,293 (Jahn) provides two separate, independent coaters located on the dampener side of a converted printing unit for applying lacquer to a plate and to a rubber blanket. Consequently, although a plate and blanket are provided, the coating unit of Jahn's press is restricted to a dedicated coating operation only.

Proposals have been made for overcoming the loss of a printing unit when in-line coating is used, for example as set forth in U.S. Pat. No. 5,176,077 to Howard W. DeMoore (co-inventor and assignee), which discloses a coating apparatus having an applicator roller positioned to apply the coating material to the freshly printed sheet while the sheet is still on the last impression cylinder of the press. This allows the last printing unit to print and coat simultaneously, so that no loss of printing unit capability results.

Some conventional coaters are rail-mounted and occupy a large amount of press space and reduce access to the press. Elaborate equipment is needed for retracting such coaters from the operative coating position to the inoperative position, which reduces access to the printing unit.

Accordingly, there is a need for an in-line inking/coating apparatus which does not result in the loss of a printing unit, does not extend the length of the press, and which can print and coat aqueous and flexographic inks and coating materials simultaneously onto the plate and blanket on any lithographic printing unit of any lithographic printing press, including the first printing unit.

OBJECTS OF THE INVENTION

Accordingly, a general object of the present invention is to provide improved inking/coating apparatus which is capable of selectively applying ink or coating material to a plate on a plate cylinder or ink or coating material to a plate or blanket on a blanket cylinder.

A specific object of the present invention is to provide improved inking/coating apparatus of the character described which is extendable into inking/coating engagement with either a plate on a plate cylinder or to a plate or blanket on a blanket cylinder.

A related object of the present invention is to provide improved inking/coating apparatus of the character described which is capable of being mounted on any lithographic printing unit of the press and does not interfere with operator access to the plate cylinder, blanket cylinder, or adjacent printing units.

Another object of the present invention is to provide improved inking/coating apparatus of the character described, which can be moved from an operative inking/coating engagement position adjacent to a plate cylinder or a blanket cylinder to a non-operative, retracted position.

Still another object of the present invention is to provide improved inking/coating apparatus of the character described, which can be used for applying aqueous, flexographic and ultra-violet curable inks and/or coatings in combination with lithographic, flexographic and waterless printing processes on any rotary offset printing press.

A related object of the present invention is to provide improved inking/coating apparatus of the character described which is capable of applying aqueous or flexographic ink or coating material on one printing unit, for example the first printing unit, and drying the ink or coating material before it is printed or coated on the next printing unit so that it can be overprinted or overcoated immediately on the next printing unit with waterless, aqueous, flexographic or lithographic inks or coating materials.

Yet another object of the present invention is to provide improved inking/coating apparatus for use on a multiple color rotary offset printing press that can apply ink or coating material separately and/or simultaneously to the plate and/or blanket of a printing unit of the press from a single operative position, and from a single inking/coating apparatus.

A related object of the present invention is to provide improved inking/coating apparatus of the character described, in which virtually no printing unit adjustment or alteration is required when the inking/coating apparatus is converted from plate to blanket printing or coating and vice versa.

Another object of the present invention is to provide improved inking/coating apparatus that can be operably mounted in the dampener space of any lithographic printing unit for inking/coating engagement with either a plate on a plate cylinder or a plate or blanket on a blanket cylinder, and which does not interfere with operator movement or activities in the interunit space between printing units.

SUMMARY OF THE INVENTION

The foregoing objects are achieved by a retractable, in-line inking/coating apparatus which is mounted on the dampener side of any printing unit of a rotary offset press for movement between an operative (on-impression) inking/coating position and a retracted, disengaged (off-impression) position. The inking/coating apparatus includes an applicator roller which is movable into and out of engagement with a plate on a plate cylinder or a blanket on a blanket cylinder. The inking/coating applicator head is pivotally coupled to a printing unit by pivot pins which are mounted on the press side frames in the traditional dampener space of the printing unit in parallel alignment with the plate cylinder and the blanket cylinder. This dampener space mounting arrangement allows the inking/coating unit to be installed between any adjacent printing units on the press.

In the preferred embodiment, the applicator head includes vertically spaced pairs of cradle members with one cradle pair being adapted for supporting an inking/coating applicator roller in alignment with a plate cylinder, and the other cradle pair supporting an inking/coating applicator roller in alignment with the blanket cylinder, respectively, when the applicator head is in the operative position. Because of the pivotal support provided by the pivot pins, the applicator head can be extended and retracted within the limited space available in the traditional dampener space, without restricting operator access to the printing unit cylinders and without causing a printing unit to lose its printing capability.

When the inking/coating apparatus is used in combination with a flexographic printing plate and aqueous or flexographic ink or coating material, the water component of the aqueous or flexographic ink or coating material on the freshly printed or coated sheet is evaporated and dried by a high velocity, hot air interunit dryer and a high volume heat and moisture extractor assembly so that the freshly printed ink or coating material is dry before the sheet is printed or coated on the next printing unit. This quick drying process permits a base layer or film of ink, for example opaque white or metallic (gold, silver or other metallics) ink to be printed on the first printing unit, and then overprinted on the next printing unit without back-trapping or dot gain.

The construction and operation of the present invention will be understood from the following detailed description taken in conjunction with the accompanying drawings which disclose, by way of example, the principles and advantages of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a sheet fed, rotary offset printing press having inking/coating apparatus embodying the present invention;

FIG. 2 is a simplified perspective view of the single head, dual cradle inking/coating apparatus of the present invention;

FIG. 3 is a schematic side elevational view of the printing press of FIG. 1 having single head, dual cradle inking/coating apparatus installed in the traditional dampener position of the first, second and last printing units;

FIG. 4 is a simplified side elevational view showing the single head, dual cradle inking/coating apparatus in the operative inking/coating position for simultaneously printing on the printing plate and blanket on the fourth printing unit;

FIG. 5 is a simplified side elevational view showing the single head, dual cradle inking/coating apparatus in the operative position for spot or overall inking or coating on the blanket of the first printing unit, and showing the dual cradle inking/coating apparatus in the operative position for spot or overall inking or coating on the printing plate of the second printing unit;

FIG. 6 is a simplified side elevational view of the single head, dual cradle inking/coating apparatus of FIG. 4 and FIG. 5, partially broken away, showing the single head, dual cradle inking/coating apparatus in the operative coating position and having a sealed doctor blade reservoir assembly for spot or overall coating on the blanket;

FIG. 7 is a schematic view showing a heat exchanger and pump assembly connected to the single head, dual cradle inking/coating apparatus for circulating temperature controlled ink or coating material to the inking/coating apparatus;

FIG. 8 is a side elevational view, partially broken away, and similar to FIG. 6 which illustrates an alternative coating head arrangement;

FIG. 9 is a simplified elevational view of a printing unit which illustrates pivotal coupling of the inking/coating apparatus on the printing unit side frame members,

FIG 10 is a view similar to FIG. 2 in which a pair of split applicator rollers are mounted in the upper cradle and lower cradle, respectively;

FIG. 11 is a side elevational view of a split applicator roller;

FIG. 12 is a perspective view of a doctor blade reservoir which is centrally partitioned by a seal element;

FIG 13 is a sectional view showing sealing engagement of the split applicator roller against the partition seal element of FIG. 12;

FIG 14 is a view similar to FIG. 8 which illustrates an alternative inking/coating embodiment;

FIG. 15 is a simplified side elevational view of a substrate which has a bronzed-like finish which is applied by simultaneous operation of the dual applicator roller embodiment of FIG. 14;

FIG. 16 is a side elevational view, partly in section, of a pan roller having separate transfer surfaces mounted on a split fountain pan;

FIG. 17 is a simplified side elevational view of the dual cradle inking/coating apparatus, partially broken away, which illustrates an alternative inking/coating head apparatus featuring a single doctor blade assembly, anilox applicator roller mounted on the lower cradle; and

FIG. 18 is a side elevational view, partly in section, of a single doctor blade anilox applicator roller assembly having separate transfer surfaces, and a split fountain pan having separate fountain compartments, with the separate fountain compartments being supplied with different inks or coating materials from separate off-press sources.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

As used herein, the term "processed" refers to printing and coating methods which can be applied to either side of a substrate, including the application of lithographic, waterless, UV-curable, aqueous and flexographic inks and/or coatings. The term "substrate" refers to sheet and web material. Also, as used herein, the term "waterless printing plate" refers to a printing plate having image areas and non-image areas which are oleophilic and oleophobic, respectively. "Waterless printing ink" refers to an oil-based ink which does not contain a significant aqueous component. "Flexographic plate" refers to a flexible printing plate having a relief surface which is wettable by flexographic ink or coating material. "Flexographic printing ink or coating material" refers to an ink or coating material having a base constituent of either water, solvent or UV-curable liquid. "UV-curable lithographic printing ink and coating material" refers to oil-based printing inks and coating materials that can be cured (dried) photomechanically by exposure to ultraviolet radiation, and that have a semi-paste or gel-like consistency. "Aqueous printing ink or coating material" refers to an ink or coating material that predominantly contains water as a solvent, diluent or vehicle. A "relief plate" refers to a printing plate having image areas which are raised relative to non-image areas which are recessed.

As shown in the exemplary drawings, the present invention is embodied in a new and improved in-line inking/coating apparatus, herein generally designated 10, for applying aqueous, flexographic or UV-curable inks or protective and/or decorative coatings to sheets or webs printed in a sheet-fed or web-fed, rotary offset printing press, herein generally designated 12. In this instance, as shown in FIG. 1, the inking/coating apparatus 10 is installed in a four unit rotary offset printing press 12, such as that manufactured by Heidelberger Druckmaschinen AG of Germany under its designation Heidelberg Speedmaster SM102 (40", 102 cm).

The press 12 includes a press frame 14 coupled at one end, herein the right end, to a sheet feeder 16 from which sheets, herein designated S, are individually and sequentially fed into the press, and at the opposite end, with a sheet delivery stacker 20 in which the freshly printed sheets are collected and stacked. Interposed between the sheet feeder 16 and the sheet delivery stacker 20 are four substantially identical sheet printing units 22, 24, 26 and 28 which can print four different colors onto the sheets as they are transferred through the press 12. The printing units are housed within printing towers T1, T2, T3 and T4 formed by side frame members 14, 15. Each printing tower has a delivery side 25 and a dampener side 27. A dampener space 29 is partially enclosed by the side frames on the dampener side of the printing unit.

As illustrated, the printing units 22, 24, 26 and 28 are substantially identical and of conventional design. The first printing unit 22 includes an in-feed transfer cylinder 30, a plate cylinder 32, a blanket cylinder 34 and an impression cylinder 36, all supported for rotation in parallel alignment between the press side frames 14, 15 which define printing unit towers T1, T2, T3 and T4. Each of the first three printing units 22, 24 and 26 have a transfer cylinder 38 disposed to transfer the freshly printed sheets from the adjacent impression cylinder and transfer the freshly printed sheets to the next printing unit via an intermediate transfer drum 40.

The last printing unit 28 includes a delivery cylinder 42 mounted on a delivery shaft 43. The delivery cylinder 42 supports the freshly printed sheet 18 as it is transferred from the last impression cylinder 36 to a delivery conveyor system, generally designated 44, which transfers the freshly printed sheet to the sheet delivery stacker 20. To prevent smearing during transfer, a flexible covering is mounted on the delivery cylinder 42, as described and claimed in U.S. Pat. No. 4,402,267 to Howard W. DeMoore, which is incorporated herein by reference. The flexible covering is manufactured and sold by Printing Research, Inc. of Dallas, Tex., U.S.A., under its trademark SUPER BLUE®. Optionally, a vacuum-assisted sheet transfer assembly manufactured and sold by Printing Research, Inc. of Dallas, Tex., U.S.A., under its trademark BACVAC® can be substituted for the delivery transfer cylinder 42 and flexible covering.

The delivery conveyor system 44 as shown in FIG. 2 is of conventional design and includes a pair of endless delivery gripper chains 46, only one of which is shown carrying at regular spaced locations along the chains, laterally disposed gripper bars having gripper fingers used to grip the leading edge of a freshly printed or coated sheet 18 after it leaves the nip between the impression cylinder 36 and delivery cylinder 42 of the last printing unit 28. As the leading edge is gripped by the gripper fingers, the delivery chains 46 pull the sheet away from the last impression cylinder 36 and convey the freshly printed or coated sheet to the sheet delivery stacker 20.

Prior to reaching the delivery sheet stacker, the freshly printed and/or coated sheets S pass under a delivery dryer 48 which includes a combination of infra-red thermal radiation, high velocity hot air flow and a high performance heat and moisture extractor for drying the ink and/or the protective/

decorative coating. Preferably, the delivery dryer 48, including the high performance heat and moisture extractor is constructed as described in U.S. application Ser. No. 08/116,711, filed Sep. 3, 1993, entitled "Infra-Red Forced Air Dryer and Extractor" by Howard C. Secor, Ronald M. Rendleman and Paul D. Copenhaver, commonly assigned to the assignee of the present invention, Howard W. DeMoore, and licensed to Printing Research, Inc. of Dallas, Tex., U.S.A., which manufactures and markets the delivery dryer 48 under its trademark AIR BLANKET™.

In the exemplary embodiment shown in FIG. 3, the first printing unit 22 has a flexographic printing plate PF mounted on the plate cylinder, and therefore neither an inking roller train nor a dampening system is required. A flexographic printing plate PF is also mounted on the plate cylinder of the second printing unit 24. The form rollers of the inking roller train 52 shown mounted on the second printing unit 24 are retracted and locked off to prevent plate contact. Flexographic ink is supplied to the flexographic plate PF of the second printing unit 24 by the inking/coating apparatus 10.

A suitable flexographic printing plate PF is offered by E.I. du Pont de Nemours of Wilmington, Del., U.S.A., under its trademark CYREL®. Another source is BASF Aktiengesellschaft of Ludwigshafen, Germany, which offers a suitable flexographic printing plate under its trademark NYLOFLEX®.

The third printing unit 26 as illustrated in FIG. 3 and FIG. 4 is equipped for lithographic printing and includes an inking apparatus 50 having an inking roller train 52 arranged to transfer ink Q from an ink fountain 54 to a lithographic plate P mounted on the plate cylinder 32. This is accomplished by a fountain roller 56 and a ductor roller 57. The fountain roller 56 projects into the ink fountain 54, whereupon its surface picks up ink. The lithographic printing ink Q is transferred from the fountain roller 56 to the inking roller train 52 by the ductor roller 57. The inking roller train 52 supplies ink Q to the image areas of the lithographic printing plate P.

The lithographic printing ink Q is transferred from the lithographic printing plate P to an ink receptive blanket B which is mounted on the blanket cylinder 34. The inked image carried on the blanket B is transferred to a substrate S as the substrate is transferred through the nip between the blanket cylinder 34 and the impression cylinder 36.

The inking roller arrangement 52 illustrated in FIG. 3 and FIG. 4 is exemplary for use in combination with lithographic ink printing plates P. It is understood that a dampening system 58 having a dampening fluid reservoir DF is coupled to the inking roller train 52 (FIG. 4), but is not required for waterless or flexographic printing.

The plate cylinder 32 of printing unit 28 is equipped with a waterless printing plate PW. Waterless printing plates are also referred to as dry planographic printing plates and are disclosed in the following U.S. Pat. Nos.: 3,910,187, Re. 30,670; 4,086,093; and 4,853,313. Suitable waterless printing plates can be obtained from Toray Industries, Inc. of Tokyo, Japan. A dampening system is not used for waterless printing, and waterless (oil-based) printing ink is used. The waterless printing plate PW has image areas and non-image areas which are oleophilic/hydrophilic and oleophobic/hydrophobic, respectively. The waterless printing plate PW is engraved or etched, with the image areas being recessed with respect to the non-image areas. The image area of the waterless printing plate PW is rolled-up with the flexographic or aqueous printing ink which is transferred by the applicator roller 66. Both aqueous and oil-based inks and coatings are repelled from the non-image areas, and are retained in the image areas. The printing ink or coating is then transferred from the image areas to an ink or coating receptive blanket B and is printed or coated onto a substrate S.

For some printing jobs, a flexographic plate PF or a waterless printing plate PW is mounted over a resilient packing such as the blanket B on the blanket cylinder 34, for example as indicated by phantom lines in printing unit 22 of FIG. 5. An advantage of this alternative embodiment is that the waterless plate PW or the flexographic plate PF are resiliently supported over the blanket cylinder by the underlying blanket B or other resilient packing. The radial deflection and give of the resilient blanket B provides uniform, positive engagement between the applicator roller 66 and a flexographic plate or waterless plate.

In that arrangement, a plate is not mounted on the plate cylinder 32; instead, a waterless plate PW is mounted on the blanket cylinder, and the inked image on the waterless printing plate is not offset but is instead transferred directly from the waterless printing plate PW to the substrate S. The water component of flexographic ink on the freshly printed sheet is evaporated by high velocity, hot air dryers and high volume heat and moisture extractors so that the freshly printed aqueous or flexographic ink is dried before the substrate is printed on the next printing unit.

Referring now to FIG. 2, FIG. 3 and FIG. 9, the inking/coating apparatus 10 is pivotally mounted on the side frames 14, 15 for rotation about an axis X. The inking/coating apparatus 10 includes a frame 60, a hydraulic motor 62, a lower gear train 64, an upper gear train 65, an applicator roller 66, a sealed doctor blade assembly 68 (FIG. 6), and a drip pan DP, all mounted on the frame 60. The external peripheral surface of the applicator roller 66 is wetted by contact with liquid coating material or ink contained in a reservoir 70.

The hydraulic motor 62 drives the applicator roller 66 synchronously with the plate cylinder 32 and the blanket cylinder 34 in response to an RPM control signal from the press drive (not illustrated) and a feedback signal developed by a tachometer 72. While a hydraulic drive motor is preferred, other drive means such as an electric drive motor or an equivalent can be used.

When using waterless printing plate systems, the temperature of the waterless printing ink and of the waterless printing plate must be closely controlled for good image reproduction. For example, for waterless offset printing with TORAY waterless printing plates PW, it is absolutely necessary to control the waterless printing plate surface and waterless ink temperature to a very narrow range, for example 24° C. (75° F.) to 27° C. (80° F.).

Referring to FIG. 7, the reservoir 70 is supplied with ink or coating which is temperature controlled by a heat exchanger 71. The temperature controlled ink or coating material is circulated by a positive displacement pump, for example a peristaltic pump, through the reservoir 70 and heat exchanger 71 from a source 73 through a supply conduit 75 and a return conduit 77. The heat exchanger 71 cools or heats the ink or coating material and maintains the ink or coating and the printing plate within the desired narrow temperature range.

According to one aspect of the present invention, aqueous/flexographic ink or coating material is supplied to the applicator roller 66, which transfers the aqueous/flexographic ink or coating material to the printing plate

(FIG. 7), which may be a waterless printing plate or a flexographic printing plate. When the inking/coating apparatus is used for applying aqueous/flexographic ink or coating material to a waterless printing plate PW, the inking roller train 52 is not required, and is retracted away from the printing plate. Because the viscosity of aqueous/flexographic printing ink or coating material varies with temperature, it is necessary to heat or cool the aqueous/flexographic printing ink or coating material to compensate for ambient temperature variations to maintain the ink viscosity in a preferred operating range.

For example, the temperature of the printing press can vary from around 60° F. (15° C.) in the morning, to around 85° F. (29° C.) or more in the afternoon. The viscosity of aqueous/flexographic printing ink or coating material can be marginally high when the ambient temperature of the press is near 60° F. (15° C.), and the viscosity can be marginally low when the ambient temperature of the press exceeds 85° F. (29° C.). Consequently, it is desirable to control the temperature of the aqueous/flexographic printing ink or coating material so that it will maintain the surface temperature of waterless printing plates within the specified temperature range. Moreover, the ink/coating material temperature should be controlled to maintain the tack of the aqueous/flexographic printing ink or coating material within a desired range when the ink or coating material is being used in connection with flexographic printing processes.

The applicator roller 66 is preferably an anilox fluid metering roller which transfers measured amounts of printing ink or coating material to a plate or blanket. The surface of an anilox roller is engraved with an array of closely spaced, shallow depressions referred as "cells". Ink or coating from the reservoir 70 flows into the cells as the anilox roller turns through the reservoir. The transfer surface of the anilox roller is "doctored" (wiped or scraped) by dual doctor blades 68A, 68B to remove excess ink or coating material. The ink or coating metered by the anilox roller is that contained within the cells. The dual doctor blades 68A, 68B also seal the supply reservoir 70.

The anilox applicator roller 66 is cylindrical and may be constructed in various diameters and lengths, containing cells of various sizes and shapes. The volumetric capacity of an anilox roller is determined by cell size, shape and number of cells per unit area. Depending upon the intended application, the cell pattern may be fine (many small cells per unit area) or coarse (fewer large cells per unit area).

By supplying the ink or coating material through the inking/coating apparatus 10, more ink or coating material can be applied to the sheet S as compared with the inking roller train of a lithographic printing unit. Moreover, color intensity is stronger and more brilliant because the aqueous or flexographic ink or coating material is applied at a much heavier film thickness or weight than can be applied by the lithographic process, and the aqueous or flexographic colors are not diluted by dampening solution.

Preferably, the sealed doctor blade assembly 68 is constructed as described in U.S. Pat. No. 5,176,077 to Howard W. DeMoore, co-inventor and assignee, which is incorporated herein by reference. An advantage of using a sealed reservoir is that fast drying ink or coating material can be used. Fast drying ink or coating material can be used in an open fountain 53 (see FIG. 8); however, open air exposure causes the water and solvents in the fast-drying ink or coating material to evaporate faster, thus causing the ink or coating material to dry prematurely and change viscosity. Moreover, an open fountain emits unwanted odors into the press room. When the sealed doctor blade assembly is utilized, the pump (FIG. 7) which circulates ink or coating material to the doctor blade head is preferably a peristaltic pump, which does not inject air into the feeder lines which supply the ink or coating reservoir 70 and helps to prevent the formation of air bubbles and foam within the ink or coating material.

An inking/coating apparatus 10 having an alternative applicator roller arrangement is illustrated in FIGS. 10–13. In this arrangement, the engraved metering surface of the anilox applicator rollers 66, 67 are partitioned by smooth seal surfaces 66C which separates a first engraved peripheral surface portion 66A from a second engraved peripheral surface portion 66B. Likewise, smooth seal surfaces 66D, 66E are formed on the opposite end portions of the applicator roller 66 for engaging end seals 134, 136 (FIG. 12) of the doctor blade reservoir. The upper applicator roller 67 has engraved anilox metering surfaces 67A and 67B which are separated by a smooth seal band 67C.

Referring now to FIG. 12 and FIG. 13, the reservoir 70 of the doctor blade head 68 is partitioned by a curved seal element 130 to form two separate chambers 70A, 70B. The seal element 130 is secured to the doctor blade head within an annular groove 132. The seal element 130 is preferably made of polyurethane foam or other durable, resilient foam material. The seal element 130 is engaged by the seal band 66, thus forming a rotary 30 seal which blocks the leakage of ink or coating material from one reservoir chamber into the other reservoir chamber. Moreover, the seal band provides an unprinted or uncoated area which separates the printed or coated areas from each other, which is needed for work and turn printing jobs or other printing jobs which print two or more separate images onto the same substrate.

Another advantage of the split applicator roller embodiment is that it enables two or more flexographic inks or coating materials to be printed simultaneously within the same lithographic printing unit. That is, the reservoir chambers 70A, 70B of the upper doctor blade assembly can be supplied with gold ink and silver ink, for example, while the reservoir chambers 70A, 70B of the lower doctor blade assembly can be supplied with inks of two additional colors, for example opaque white ink and blue ink. This permits the opaque white ink to be overprinted with the gold ink, and the blue ink to be overprinted with the silver ink on the same printing unit on any lithographic press.

Moreover, a catalyst can be used in the upper doctor blade reservoir and a reactive ink or coating material can be used in the lower doctor blade reservoir. This can provide various effects, for example improved chemical resistance and higher gloss levels.

The split applicator roller sections 67A, 67B in the upper cradle position can be used for applying two separate inks or coating materials simultaneously, for example flexographic, aqueous and ultra-violet curable inks or coating materials, to separate surface areas of the plate, while the lower applicator roller sections 66A, 66B can apply an initiator layer and a microencapsulated layer simultaneously to separate blanket surface areas. Optionally, the metering surface portions 66A, 66B can be provided with different cell metering capacities for providing different printing effects which are being printed simultaneously. For example, the screen line count on one half-section of an anilox applicator roller is preferably in the range of 200–600 lines per inch (79–236 lines per cm) for half-tone images, and the screen line count of the other half-section is preferably in the range of 100–300 lines per inch (39–118 lines per cm) for overall coverage, high

weight applications such as opaque white. This split arrangement in combination with dual applicator rollers is particularly advantageous when used in connection with "work and turn" printing jobs.

Referring again to FIG. 8, instead of using the sealed doctor blade reservoir assembly 68 as shown in FIG. 6, an open fountain assembly 69 is provided by the fountain pan 53 which contains a volume of liquid ink Q or coating material. The liquid ink or coating material is transferred to the applicator roller 66 by a pan roller 55 which turns in contact with ink Q or coating material in the fountain pan. If a split applicator roller is used, the pan roller 55 is also split, and the pan is divided into two pan sections 53A, 53B by a separator plate 53P, as shown in FIG. 16.

In the alternative embodiment of FIG. 16, the pan roller 55 is divided into two pan roller sections 55A, 55B by a centrally located, annular groove 59. The separator plate 53P is received within and centrally aligned with the groove 59, but does not touch the adjoining roller faces. By this arrangement, two or more inks or coating materials Q1, Q2 are contained within the open pan sections 55A, 55B for transfer by the split pan roller sections 53A, 53B, respectively. This permits two or more flexographic inks or coating materials to be transferred to two separate image areas on the plate or on the blanket of the same printing unit. This arrangement is particularly advantageous for work and turn printing jobs or other printing jobs which print two or more separate images onto the same substrate.

The frame 60 of the inking/coating apparatus 10 includes side support members 74, 76 which support the applicator roller 66, gear train 64, gear train 65, doctor blade assembly 68 and the drive motor 62. The applicator roller 66 is mounted on stub shafts 63A, 63B which are supported at opposite ends on a lower cradle assembly 100 formed by a pair of side support members 78, 80 which have sockets 79, 81 and retainer caps 101, 103. The stub shafts are received in roller bearings 105, 107 which permit free rotation of the applicator roller 66 about its longitudinal axis A1 (axis A2 in the upper cradle). The retainer caps 101, 103 hold the stub shafts 63A, 63B and bearings 105, 107 in the sockets 79, 81 and hold the applicator roller 66 in parallel alignment with the pivot axis X.

The side support members 74, 76 also have an upper cradle assembly 102 formed by a pair of side support members 82, 84 which are vertically spaced with respect to the lower side plates 78, 80. Each cradle 100, 102 has a pair of sockets 79, 81 and 83, 85, respectively, for holding an applicator roller 66, 67 for spot coating or inking engagement with the printing plate P on the plate cylinder 32 (FIG. 4) or with a printing plate P or a blanket B on the blanket cylinder 34.

Preferably, the applicator roller 67 (FIG. 8, FIG. 9) the upper cradle (plate) position is an anilox roller having a resilient transfer surface. In the dual cradle arrangement as shown in FIG. 2, the press operator can quickly change from blanket inking/coating to plate inking/coating within minutes, since it is only necessary to release, remove and reposition or replace the applicator roller 66.

The capability to simultaneously print in the flexographic mode, the aqueous mode, the waterless mode, or the lithographic mode on different printing units of the same lithographic press and to print or coat from either the plate position or the blanket position on any one of the printing units is referred to herein as the LITHOFLEX™ printing process or system. LITHOFLEX™ is a trademark of Printing Research, Inc. of Dallas, Tex., U.S.A., exclusive licensee of the present invention.

Referring now to FIG. 14, an inking/coating apparatus 10 having an inking/coating assembly 109 of an alternative design is installed in the upper cradle position for applying ink and/or coating material to a plate P on the plate cylinder 32. According to this alternative embodiment, an applicator roller 67R having a resilient transfer surface is coupled to an anilox fluid metering roller which transfers measured amounts of printing ink or coating material to the plate P. The anilox roller 111 has a transfer surface constructed of metal, ceramic or composite material which is engraved with cells. The resilient applicator roller 67R is interposed in transfer engagement with the plate P and the metering surface of the anilox roller 111. The resilient transfer surface of the applicator roller 67R provides uniform, positive engagement with the plate.

Referring now to FIG. 17, an inking/coating apparatus 10 having an alternative inking/coating assembly 113 is installed in the lower cradle assembly 100 for applying flexographic or aqueous ink and/or coating material Q to a plate or blanket mounted on the blanket cylinder 34. Instead of using the sealed, dual doctor blade reservoir assembly 68 as shown in FIG. 6, an open, single doctor blade anilox roller assembly 113 is supplied with liquid ink Q or coating material contained in an open fountain pan 117. The liquid ink or coating material Q is transferred to the engraved transfer surface of the anilox roller 66 as it turns in the fountain pan 117. Excess ink or coating material Q is removed from the engraved transfer surface by a single doctor blade 68B. The liquid ink or coating material Q is pumped from an off-press source, for example the drum 73 shown in FIG. 17, through a supply conduit 119 into the fountain pan 117 by a pump 120.

For overall inking or coating jobs, the metering transfer surface of the anilox roller 66 extends over its entire peripheral surface. However, for certain printing jobs which print two or more separate images onto the same substrate, for example work and turn printing jobs, the metering transfer surface of the anilox applicator roller 66 is partitioned by a centrally located, annular undercut groove 66C which separates first and second metering transfer surfaces 66A, 66B as shown in FIG. 11 and FIG. 18.

The single doctor blade 68B has an edge 68E which wipes simultaneously against the split metering transfer surfaces 66A, 66B. In this single blade, split anilox roller embodiment 113, it is necessary to provide dual supply sources, for example drums 73A, 73B, dual supply lines 119A, 119B, and dual pumps 120A, 120B. Moreover, the fountain pan 117 is also split, and the pan 117 is divided into two pan sections 117A, 117B by a separator plate 121, as shown in FIG. 18. The separator plate 121 is centrally aligned with the undercut groove 66C, but does not touch the adjoining roller faces.

Although the single blade, split anilox applicator roller assembly 113 is shown mounted in the lower cradle position (FIG. 17), it should be understood that the single blade, split anilox applicator roller assembly 113 can be mounted and used in the upper cradle position, as well.

According to another aspect of the present invention, the inking/coating apparatus 10 is pivotally coupled on horizontal pivot pins 88P, 90P which allows the single head, dual cradle inking/coating apparatus 10 to be mounted on any lithographic printing unit. Referring to FIG. 9, the horizontal pivot pins 88P, 90P are mounted within the traditional dampener space 29 of the printing unit and are secured to the press side frames 14, 15, respectively. Preferably, the pivot support pins 88P, 90P are secured to the press side frames by

a threaded fastener. The pivot support pins are received within circular openings 88, 90 which intersect the side support members 74, 76 of the inking/coating apparatus 10. The horizontal support pins 88P, 90P are disposed in parallel alignment with rotational axis X and with the plate cylinder and blanket cylinder, and are in longitudinal alignment with each other.

Preferably, the pivot pins 88P, 90P are located in the dampener space 29 so that the rotational axes A1, A2 of the applicator rollers 66, 67 are elevated with respect to the nip contact points N1, N2. By that arrangement, the transfer point between the applicator roller 66 and a blanket on the blanket cylinder 34 (as shown in FIG. 8) and the transfer point between the applicator roller 66 and a plate on the plate cylinder 32 (as shown in FIG. 5) are above the radius lines R1, R2 of the plate cylinder and the blanket cylinder, respectively. This permits the inking/coating apparatus 10 to move clockwise to retract the applicator roller 66 to an off-impression position relative to the blanket cylinder in response to a single extension stroke of the power actuator arms 104A, 106A. Similarly, the applicator roller 66 is moved counterclockwise to the on-impression operative position as shown in FIGS. 4, 5, 6 and 8 by a single retraction stroke of the actuator arms 104A, 106A, respectively.

Preferably, the pivot pins are made of steel and the side support members are made of aluminum, with the steel pivot pins and the aluminum collar portion bordering the circular openings 88, 90 forming a low friction journal. By this arrangement, the inking/coating apparatus 10 is freely rotatable clockwise and counterclockwise with respect to the pivot pins 88P, 90P. Typically, the arc length of rotation is approximately 60 mils (about 1.5 mm). Consequently, the inking/coating apparatus 10 is almost totally enclosed within the dampener space 29 of the printing unit in the on-impression position and in the off-impression position.

The cradle assemblies 100 and 102 position the applicator roller 66 in inking/coating alignment with the plate cylinder or blanket cylinder, respectively, when the inking/coating apparatus 10 is extended to the operative (on-impression) position. Moreover, because the inking/coating apparatus 10 is installed within the dampener space 29, it is capable of freely rotating through a small arc while extending and retracting without being obstructed by the press side frames or other parts of the printing press. This makes it possible to install the inking/coating apparatus 10 on any lithographic printing unit. Moreover, because of its internal mounting position within the dampener space 29, the projection of the inking/coating apparatus 10 into the space between printing units is minimal. This assures unrestricted operator access to the printing unit when the applicator head is in the operative (on-impression) and retracted (off-impression) positions.

As shown in FIG. 4 and FIG. 5, movement of the inking/coating apparatus 10 is counterclockwise from the retracted (off-impression) position to the operative (on-impression) position.

Although the dampener side installation is preferred, the inking/coating apparatus 10 can be adapted for operation on the delivery side of the printing unit, with the inking/coating apparatus being movable from a retracted (off-impression) position to an on-impression position for engagement of the applicator roller with either a plate on the plate cylinder or a blanket on the blanket cylinder on the delivery side 25 of the printing unit.

Movement of the inking/coating apparatus 10 to the operative (on-impression) position is produced by power actuators, preferably double acting pneumatic cylinders 104, 106 which have extendable/retractable power transfer arms 104A, 106A, respectively. The first pneumatic cylinder 104 is pivotally coupled to the press frame 14 by a pivot pin 108, and the second pneumatic cylinder 106 is pivotally coupled to the press frame 15 by a pivot pin 110. In response to selective actuation of the pneumatic cylinders 104, 106, the power transfer arms 104A, 106A are extended or retracted. The power transfer arm 104A is pivotally coupled to the side support member 74 by a pivot pin 112. Likewise, the power transfer arm 106A is pivotally coupled to the side support member 76 by a pivot pin 114.

As the power arms extend, the inking/coating apparatus 10 is rotated clockwise on the pivot pins 88P, 90P, thus moving the applicator roller 66 to the off-impression position. As the power arms retract, the inking/coater apparatus 60 is rotated counterclockwise on the pivot pins 88P, 90P, thus moving the applicator roller 66 to the on-impression position. The torque applied by the pneumatic actuators is transmitted to the inking/coating apparatus 10 through the pivot pin 112 and pivot pin 114.

Fine adjustment of the on-impression position of the applicator roller relative to the plate cylinder or the blanket cylinder, and of the pressure of roller engagement, is provided by an adjustable stop assembly 115. The adjustable stop assembly 115 has a threaded bolt 116 which is engagable with a bell crank 118.

The bell crank 118 is pivotally coupled to the side support member 74 on a pin 120. One end of the bell crank 118 is engagable by the threaded bolt 116, and a cam roller 122 is mounted for rotation on its opposite end. The striking point of engagement is adjusted by rotation of the bolt 116 so that the applicator roller 66 is properly positioned for inking/coating engagement with the plate P or blanket B and provides the desired amount of inking/coating pressure when the inking/coating assembly 60 is moved to the operative position.

This arrangement permits the in-line inking/coating apparatus to operate effectively without encroaching in the interunit space between any adjacent printing units, and without blocking or obstructing access to the cylinders of the printing units when the inking/coating apparatus is in the extended (off-impression) position or retracted (on-impression) position. Moreover, when the in-line inking/coating apparatus is in the retracted position, the doctor blade reservoir and coating circulation lines can be drained and flushed automatically while the printing press is running as well as when the press has been stopped for change-over from one job to another or from one type of ink or coating to another.

Substrates which are printed or coated with aqueous flexographic printing inks require high velocity hot air for drying. When printing a flexographic ink such as opaque white or metallic gold, it is always necessary to dry the printed substrates between printing units before overprinting them. According to the present invention, the water component on the surface of the freshly printed or coated substrate S is evaporated and dried by high velocity, hot air interunit dryer and high volume heat and moisture extractor units 124, 126 and 128, as shown in FIG. 2, FIG. 4 and FIG. 5. The dryer/extractor units 124, 126 and 128 are oriented to direct high velocity heated air onto the freshly printed/coated substrates as they are transferred by the impression cylinder 36 and the intermediate transfer drum 40 of one printing unit and to another transfer cylinder 30 and to the impression cylinder 36 of the next printing unit. By that

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arrangement, the freshly printed flexographic ink or coating material is dried before the substrate S is overprinted by the next printing unit.

The high velocity, hot air dryer and high performance heat and moisture extractor units 124, 126 and 128 utilize high velocity air jets which scrub and break-up the moist air layer which clings to the surface of each freshly printed or coated sheet or web. Within each dryer, high velocity air is heated as it flows across a resistance heating element within an air delivery baffle tube. High velocity jets of hot air are discharged through multiple airflow apertures into an exposure zone Z (FIG. 4 and FIG. 5) and onto the freshly printed/coated sheet S as it is transferred by the impression cylinder 36 and transfer drum 40, respectively.

Each dryer assembly includes a pair of air delivery dryer heads 124D, 126D and 128D which are arranged in spaced, side-by-side relationship. The high velocity, hot air dryer and high performance heat and moisture extractor units 124, 126 and 128 are preferably constructed as disclosed in co-pending U.S. patent application Ser. No. 08/132,584, filed Oct. 6, 1993, entitled "High Velocity Hot Air Dryer", to Howard W. DeMoore, co-inventor and assignee of the present invention, and which is incorporated herein by reference, and which is marketed by Printing Research, Inc. of Dallas, Tex., U.S.A., under its trademark SUPER BLUE HV™.

The hot moisture-laden air displaced from the surface of each printed or coated sheet is extracted from the dryer exposure zone Z and exhausted from the printing unit by the high volume extractors 124, 126 and 128. Each extractor head includes an extractor manifold 124E, 126E and 128E coupled to the dryer heads 124D, 126D and 128D and draws the moisture, volatiles, odors and hot air through a longitudinal air gap G between the dryer heads. Best results are obtained when extraction is performed simultaneously with drying. Preferably, an extractor is closely coupled to the exposure zone Z at each dryer location as shown in FIG. 4. Extractor heads 124E, 126E and 128E are mounted on the dryer heads 124D, 126D and 128D, respectively, with the longitudinal extractor air gap G facing directly into the exposure zone Z. According to this arrangement, each printed or coated sheet is dried before it is printed on the next printing unit.

The aqueous water-based inks used in flexographic printing evaporate at a relatively moderate temperature provided by the interunit high velocity hot air dryers/extractors 124, 126 and 128. Sharpness and print quality are substantially improved since the flexographic ink or coating material is dried before it is overprinted on the next printing unit. Since the freshly printed flexographic ink is dry, dot gain is substantially reduced and back-trapping on the blanket of the next printing unit is virtually eliminated. This interunit drying/extracting arrangement makes it possible to print flexographic inks such as metallic ink and opaque white ink on the first printing unit, and then dry-trap and overprint on the second and subsequent printing units.

Moreover, this arrangement permits the first printing unit 22 to be used as a coater in which a flexographic, aqueous or UV-curable coating material is applied to the lowest grade substrate such as recycled paper, cardboard, plastic and the like, to trap and seal-in lint, dust, spray powder and other debris and provide a smoother, more durable printing surface which can be overprinted on the next printing unit.

A first down (primer) aqueous coating layer seals-in the surface of a low grade, rough substrate, for example, re-cycled paper or plastic, and improves overprinted dot definition and provides better ink lay-down while preventing strike-through and show-through. A flexographic UV-curable coating material can then be applied downstream over the primer coating, thus producing higher coating gloss.

Preferably, the applicator roller 66 is constructed of composite carbon fiber material, metal or ceramic coated metal when it is used for applying ink or coating material to the blanket B or other resilient material on the blanket cylinder 34. When the applicator roller 66 is applied to the plate, it is preferably constructed as an anilox roller having a resilient, compressible transfer surface. Suitable resilient roller surface materials include Buna N synthetic rubber and EPDM (terpolymer elastomer). EPDM is known to be completely acceptable for use with UV-curable inks and coating applications.

A demonstration resilient anilox roller was made by covering a steel core with about ½ inch of rubber to a diameter of about four inches. The rubber had a hardness of about 80 on the Shore "A" scale. The surface was laser engraved by Consolidated Engravers, 2255 West Loughborn Dr., Lancaster, Tex. 76134 with four different patterns in approximately 10 inch wide bands across the face comprising about 125,150,175 and 200 lines/inch with what was a "hexagonal" cell pattern. Satisfactory coatings were applied via the plate cylinder to a substrate with all four patterns. A second resilient anilox roll was obtained which had only one 150 lines/inch overall pattern with a cell volume of about 9 cubic billion microns (CBM). Satisfactory coating was applied from this roll against a plate. Coating was applied to the roll by a sealed doctor blade assembly like assembly 68 in FIG. 6. The roller produced useful film weight. Water based inks were applied satisfactorily in various colors. The surface speed of the plate and resilient anilox rollers were kept about the same. No reason is seen why a roller train similar to fountain assembly 69 in FIG. 8 could not be used to supply coating to a resilient anilox roller 66. The resilient anilox roller will accommodate slight variations in elevation of a printing plate or blanket much better than a ceramic or hard surface anilox roller.

It has been demonstrated in prototype testing that the inking/coating apparatus 10 can apply a wide range of ink and coating types, including fluorescent (Day Glo), pearlescent, metallics (gold, silver and other metals), glitter, scratch and sniff (micro-encapsulated fragrance), scratch and reveal, luminous, pressure-sensitive adhesives and the like, as well as UV-curable and aqueous coatings.

With the dampener assembly removed from the printing unit, the inking/coating apparatus 10 can easily be installed in the dampener space for selectively applying flexographic inks and/or coatings to a flexographic or waterless printing plate or to the blanket. Moreover, overprinting of the flexographic inks and coatings can be performed on the next printing unit since the flexographic inks and/or coatings are dried by the high velocity, hot air interunit dryer and high volume heat and moisture extractor assembly of the present invention or by Ultra Violet curing.

The flexographic inks and coatings as used in the present invention contain colored pigments and/or soluble dyes, binders which fix the pigments onto the surface of the substrate, waxes, defoamers, thickeners and solvents. Aqueous printing inks predominantly contain water as a diluent and/or vehicle. The thickeners which are preferred include algonates, starch, cellulose and its derivatives, for example cellulose esters or cellulose ethers and the like. Coloring agents including organic as well as inorganic pigments may

be derived from dyes which are insoluble in water and solvents. Suitable binders include acrylates and/or polyvinylchloride.

When metallic inks are printed, the cells of the anilox roller must be appropriately sized to prevent the metal particles from getting stuck within the cells. For example, for metallic gold ink, the anilox roller should have a screen line count in the range of 175–300 lines per inch (68-118 lines per cm). Preferably, in order to keep the anilox roller cells clear, the doctor blade assembly 68 is equipped with a bristle brush BR (FIG. 14) as set forth in U.S. Pat. No. 5,425,809 to Steven M. Person, assigned to Howard W. DeMoore, and licensed to Printing Research, Inc. of Dallas, Tex., U.S.A., which is incorporated herein by reference.

The inking/coating apparatus 10 can also apply UV-curable inks and coatings. If UV-curable inks and coatings are utilized, ultra-violet dryers/extractors are installed adjacent to the high velocity hot air dryer/extractor units 124, 126 and 128, respectively.

It will be appreciated that the LITHOFLEX™ printing process described herein makes it possible to selectively operate a printing unit of a press in the lithographic printing mode while simultaneously operating another printing unit of the same press in either the flexographic printing mode or in the waterless printing mode, while also providing the capability to print or coat, separately or simultaneously, from either the plate position or the blanket position. The dual cradle support arrangement of the present invention makes it possible to quickly change over from inking/coating on the blanket cylinder position to inking/coating on the plate cylinder position with minimum press down-time, since it is only necessary to remove and reposition or replace the applicator roller 66 while the inking/coating apparatus 10 is in the retracted position. It is only necessary to remove four cap screws, lift the applicator roller 66 from the cradle, and reposition it in the other cradle. All of this can be accomplished in a few minutes, without removing the inking/coating apparatus 10 from the press.

It is possible to spot coat or overall coat from the plate position or from the blanket position with flexographic inks or coatings on one printing unit and then spot coat or overall coat with UV-curable inks or coatings from the plate position or from the blanket position on another printing unit during the same press run. Moreover, the press operator can spot or overall coat from the plate for one job, and then spot and/or overall coat from the blanket on the next job.

The positioning of the applicator roller relative to the plate or blanket is repeatable to a predetermined preset operative position. Consequently, only minor printing unit modifications or alterations may be required for the LITHOFLEX™ process. Although automatic extension and retraction have been described in connection with the exemplary embodiment, extension to the operative (on-impression) position and retraction to a non-operative (off-impression) position can be carried out manually, if desired. In the manual embodiment, it is necessary to latch the inking/coating apparatus 10 to the press side frames 14, 15 in the operative (on-impression) position, and to mechanically prop the inking/coating apparatus in the off-impression (retracted) position.

Referring again to FIG. 8, an applicator roller 66 is mounted on the lower cradle assembly 100 by side support members 78, 80, and a second applicator roller 66 is mounted on the upper cradle assembly 102 by side support members 82, 84. According to this arrangement, the inking/coating apparatus 10 can apply printing ink and/or coating material to a plate on the plate cylinder, while simultaneously applying printing ink and/or coating material to a plate or a blanket on the blanket cylinder of the same printing unit. When the same color ink is used by the upper and lower applicator rollers from the plate position and from the blanket position simultaneously on the same printing unit, a "double bump" or double inking films or coating layers are applied to the substrate S during a single pass of the substrate through the printing unit. The tack of the two inks or coating materials must be compatible for good transfer during the double bump. Moreover, the inking/coating apparatus 10 can be used for supplying ink or coating material to the blanket cylinder of a rotary offset web press, or to the blanket of a dedicated coating unit.

According to conventional bronzing techniques, a metallic (bronze) powder is applied off-line to previously printed substrate which produces a grainy, textured finish or appearance. The on-line application of bronze material by conventional flexographic or lithographic printing will only produce a smooth, continuous appearance. However, a grainy, textured finish is preferred for highest quality printing which, prior to the present invention, could only be produced by off-line methods.

Referring now to FIG. 14 and FIG. 15, metallic ink or coating material is applied on-line to the substrate S by simultaneous operation of the upper and lower applicator rollers 67R, 66 to produce an uneven surface finish having a bronze-like textured or grainy appearance. According to the simulated bronzing method of the present invention, the flexographic bronze ink is applied simultaneously to the plate and to the blanket by the dual cradle inking/coating apparatus 10 as shown in FIG. 14. A resilient applicator roller 67R is mounted in the upper cradle 102, and an anilox applicator roller 66 is mounted on the lower cradle 100. The rollers are supplied from separate doctor blade reservoirs 70. The doctor blade reservoir 70 in the upper cradle position supplies bronze ink or coating material having relatively coarse, metallic particles 140 dispersed in aqueous or flexographic ink. The coarse particle ink or coating material is applied to the plate P by the resilient applicator roller 67R in the upper cradle position 102. At the same time, flexographic and/or bronze ink or coating material having relatively fine, metallic particles 142 is transferred to the blanket B by the anilox roller 66 which is mounted on the lower cradle 100.

The metering surfaces of the upper and lower applicator rollers have different cell sizes and volumetric capacities which accommodate the coarse and fine metallic particles. For example, the anilox roller 111 mounted in the upper cradle position 102 which transfers the coarse metallic particles 140 preferably has a screen line count in the range of 100–300 lines per inch (39–118 lines per cm), and the metering surface of the anilox roller 66 mounted on the lower cradle 100 which transfers the relatively fine metallic particles 142 preferably has a screen line count in the range of 200–600 lines per inch (79–236 lines per cm).

After transfer from the plate to the blanket, the fine metallic particles 142 form a layer over the coarse metallic particles 140. As both bronze layers are offset onto the substrate S, the layer of fine metallic particles 142 is printed onto the substrate S with the top layer of coarse metallic particles 140 providing a textured, grainy appearance. The fine metallic particles 142 cover the substrate which would otherwise be visible in the gaps between the coarse metallic particles 140. The combination of the coarse particle layer over the fine particle layer thus provides a textured, bronzed-like finish and appearance.

Particulate materials other than metal can be used for producing a textured finish. For example, coarse and fine particles of metallized plastic (glitter), mica particles (pearlescent) and the like, can be subsumed for the metallic particles for producing unlimited surface variations, appearances and effects. All of the particulate material, including the metallic particles, are preferably in solid, flat platelet form, and have a size dimension suitable for application by an anilox applicator roller. other particulate or granular material, for example stone grit having irregular form and size, can be used to good advantage.

Solid metal particles in platelet form, which are good reflectors of light, are preferred for producing the bronzed-like appearance and effect. However, various textured finishes, which could have light-reflective properties, can be produced by using granular materials such as stone grit. Most commonly used metals include copper, zinc and aluminum. other ductile metals can be used, if desired. Moreover, the coarse and fine particles need not be made of the same particulate material. Various effects and textured appearances can be produced by utilizing diverse particulate materials for the coarse particles and the fine particles, respectively. Further, either fine or coarse particle ink or coating material can be printed from the upper cradle position, and either fine or coarse particle ink or coating material can be printed from the lower cradle position, depending on the special or surface finish that is desired.

It will be appreciated that the last printing unit 28 can be configured for additional inking/coating capabilities which include lithographic, waterless, aqueous and flexographic processes. Various substrate surface effects (for example double bump or triple bump inking/coating or bronzing) can be performed on the last printing unit. For triple bump inking/coating, the last printing unit 28 is equipped with an auxiliary in-line inking or coating apparatus 97 as shown in FIG. 3 and FIG. 4. The in-line inking or coating apparatus 97 allows the application of yet another film of ink or a protective or decorative layer of coating material over any freshly printed or coated surface effects or special treatments, thereby producing a triple bump. The triple bump is achieved by applying a third film of ink or layer of coating material over the freshly printed or coated double bump simultaneously while the substrate is on the impression cylinder of the last printing unit.

When the in-line inking/coating apparatus 97 is installed, it is necessary to remove the SUPER BLUE® flexible covering from the delivery cylinder 42, and it is also necessary to modify or convert the delivery cylinder 42 for inking/coating service by mounting a plate or blanket B on the delivery cylinder 42, as shown in FIG. 3 and FIG. 4. Packing material is placed under the plate or blanket B, thereby packing the plate or blanket B at the correct packed-to-print radial clearance so that ink or coating material will be printed or coated onto the freshly printed substrate S as it transfers through the nip between the plate or blanket B on the converted delivery cylinder 42 and the last impression cylinder 36. According to this arrangement, a freshly printed or coated substrate is overprinted or overcoated with a third film or layer of ink or coating material simultaneously while a second film or layer of ink or coating material is being over-printed or over-coated on the last impression cylinder 36.

The auxiliary inking/coating apparatus 97 and the converted or modified delivery cylinder 42 are mounted on the delivery drive shaft 43. The inking/coating apparatus 97 includes an applicator roller, preferably an anilox applicator roller 97A, for supplying ink or coating material to a plate or blanket B on the modified or converted delivery cylinder 42. The in-line inking/coating apparatus 97 and the modified or converted delivery cylinder 42 are preferably constructed as described in U.S. Pat. No. 5,176,077 to Howard W. DeMoore (co-inventor and assignee), which is hereby incorporated by reference. The in-line inking/coating apparatus 97 is manufactured and sold by Printing Research, Inc. of Dallas, Tex., U.S.A., under its trademark SUPER BLUE EZ COATER™.

After the delivery cylinder 42 has been modified or converted for inking/coating service, and because of the reduced nip clearance imposed by the plate or blanket B, the modified delivery cylinder 42 can no longer perform its original function of guiding and transferring the freshly printed or coated substrate. Instead, the modified or converted delivery cylinder 42 functions as a part of the inking/coating apparatus 97 by printing or coating a third down film of ink or layer of coating material onto the freshly printed or coated substrate as it is simultaneously printed or coated on the last impression cylinder 36. Moreover, the mutual tack between the second down ink film or coating layer and the third down ink film or coating layer causes the overprinted or overcoated substrate to cling to the plate or blanket, thus opposing or resisting separation of the substrate from the plate or blanket.

To remedy this problem, a vacuum-assisted transfer apparatus 99 is mounted adjacent the modified or converted delivery cylinder 42 as shown in FIG. 3 and FIG. 4. Another purpose of the vacuum-assisted transfer apparatus 99 is to separate the freshly overprinted or overcoated triple bump substrate from the plate or blanket B as the substrate transfers through the nip. The vacuum-assisted transfer apparatus 99 produces a pressure differential across the freshly overprinted or overcoated substrate as it transfers through the nip, thus producing a separation force onto the substrate and providing a clean separation from the plate or blanket B.

The vacuum-assisted transfer apparatus 99 is preferably constructed as described in U.S. Pat. Nos. 5,113,255; 5,127,329; 5,205,217; 5,228,391; 5,243,909; and 5,419,254, all to Howard W. DeMoore, co-inventor, which are incorporated herein by reference. The vacuum-assisted transfer apparatus 99 is manufactured and sold by Printing Research, Inc. of Dallas, Tex., U.S.A. under its trademark BACVAC™.

Although the present invention and its advantages have been described in detail, it should be understood that various changes, substitutions and alterations can be made herein without departing from the spirit and scope of the present invention as defined by the appended claims.

What is claimed is:

1. In a rotary offset printing press having first and second side frame members and a plurality of printing units each having a plate cylinder, a blanket cylinder, and an impression cylinder supported for rotation in operable combination, the printing units having a delivery side and a dampener side opposite the delivery side, an interunit operator space between printing units and a dampener or a space for a dampener on the dampener side of each unit, the improvement comprising:

- a printing apparatus for inking or coating, the printing apparatus having a frame movably coupled to at least one printing unit in the space for a dampener, the printing apparatus being movable between an on-impression operative position and an off-impression retracted position;
- the movable frame supporting a removable first applicator roller and a removable second applicator roller, the first

applicator roller, being supported for adjustment into and out of ink or coating association with the plate cylinder and the second applicator roll being supported for adjustment into and out of ink or coating association with the blanket cylinder, when the printing apparatus is moved respectively to the on-impression operative position and the off-impression retracted position,

whereby a continuous or spot film of ink or coating can be applied simultaneously by the printing apparatus to a plate on the plate cylinder and the blanket cylinder and ink or coating can be selectively applied to the plate cylinder or blanket cylinder or a plate mounted thereon if one of the first or second applicator rollers is removed from the frame.

2. The invention as set forth in claim 1 wherein the printing apparatus includes:

a doctor blade assembly having a reservoir for receiving ink or coating material coupled to the first or second applicator roll.

3. The invention as set forth in claim 2, the applicator roller comprising:

a roller having a resilient transfer surface.

4. The invention as set forth in claim 1, including:

first and second pivot pins mounted on the first and second side frame members, respectively, said pivot pins extending in alignment with the rotational axis of the plate and blanket cylinders; and

the printing apparatus being pivotally coupled for rotational movement on the pivot pins.

5. The invention as set forth in claim 1, further comprising:

a power actuator pivotally coupled to the printing unit, the power actuator having a power transfer arm which is extendable and retractable; and,

apparatus coupled to the power transfer arm and to the printing apparatus for converting extension or retraction movement of the power transfer arm into pivotal movement of the printing apparatus relative to the plate and blanket cylinder.

6. The invention as set forth in claim 5, in which the movement converting apparatus comprises:

a bell crank plate having a first end portion pivotally coupled to the printing apparatus for engaging the printing unit and having a second end portion for engaging a stop member; and,

a stop member coupled to the inking or coating apparatus for engaging the second end portion of the bell crank plate.

7. The invention as set forth in claim 1, the printing apparatus comprising:

the movable frame having first and second side support members;

the ink or coating applicator rollers being mounted between the first side support member and second side support member and having a reservoir or fountain pan for receiving ink or coating material;

cradle means mounted on the first and second side support members, respectively for removably supporting the first and second applicator rollers in the movable frame;

power transfer means coupled to the applicator rollers for rotation thereof.

8. The invention as set forth in claim 7,

the cradle means including a first cradle assembly disposed on the first and second side support members, respectively, and a second cradle assembly disposed on the first and second side support members, respectively;

the first applicator roller is mounted for rotation on the first cradle assembly; and

the second applicator roller is mounted for rotation on the second cradle assembly.

9. The invention as set forth in claim 1 wherein a container means for containing liquid ink or coating material and means for applying ink or coating material from the container means to a peripheral surface portion of the first and second applicator rolls is provided and supported by the printing apparatus.

10. The invention as set forth in claim 9 wherein the container means comprises a doctor blade assembly having a reservoir or fountain pan for supplying ink or coating material to each of said applicator rollers, and having a doctor blade disposed for wiping engagement with each of said applicator rollers when it is received in rolling contact with ink or coating material in the reservoir or pan.

11. The invention as set forth in claim 9, wherein the container means comprises a fountain pan and the inking applying means comprises a pan for transferring ink or coating material from the fountain pan to said first and second applicator rollers.

12. A rotary offset printing press having a printing unit of the type having a delivery side and a dampener side, said dampener side having a dampener space for receiving a dampener, comprising, in combination:

a plate cylinder mounted on the printing unit between the delivery side and the dampener side, and a printing plate mounted on the plate cylinder;

a blanket cylinder having an ink or coating receptive blanket disposed in ink or coating transfer engagement with the plate for transferring ink or coating material from the image surface areas of the printing plate to the ink or coating receptive blanket;

an impression cylinder disposed adjacent the blanket cylinder thereby forming a nip between the blanket and the impression cylinder whereby the printing ink or coating material is transferred from the blanket to a substrate as the substrate is transferred through the nip;

support means mounted on the dampener side of the printing unit;

an inking or coating apparatus having a removable first applicator roller and a removable second applicator roller, being positioned in the dampener space in place of a dampener, the inking or coating apparatus being coupled to the support means for movement between an on-impression operative position and an off-impression retracted position wherein the first applicator roller is adjustably supported for movement into and out of ink or coating association with the plate on the plate cylinder while the second applicator roller is adjustably supported for simultaneous movement into and out of ink or coating association with the blanket on the blanket cylinder; and

whereby a continuous or spot film of ink or coating can be applied by the inking and coating apparatus to a plate on the plate cylinder and a blanket on the blanket cylinder and ink or coating can be selectively applied to the plate on the plate cylinder or the blanket cylinder blanket or a plate thereon.

13. The invention as defined in claim 12 wherein the plate cylinder, blanket cylinder, impression cylinder and inking or coating apparatus forms a first printing unit, the printing press having a second printing unit for printing or coating the substrate subsequently to the first printing unit, the printing press further including:

a dryer mounted on the printing press for discharging heated air onto a freshly printed or coated substrate from the first printing unit before the freshly printed or coated substrate is subsequently printed, coated or otherwise processed in the second printing unit.

14. The invention as defined in claim 13 wherein:

the dryer is mounted adjacent to the impression cylinder for discharging heated air onto a freshly printed or coated substrate while the substrate is in contact with the impression cylinder.

15. The invention as defined in claim 13 comprising:

an extractor coupled to the dryer for extracting hot air, moisture, odors and volatiles from an exposure zone between the dryer and the freshly printed or coated substrate.

16. The invention as defined in claim 12 wherein the printing press has an interunit position, comprising:

a transfer cylinder disposed in the interunit position on the press and coupled in sheet transfer relation with the impression cylinder; and

an interunit dryer disposed adjacent the transfer cylinder for discharging heated air onto a freshly printed or coated substrate after it has been transferred from the impression cylinder and while it is in contact with the transfer cylinder.

17. A printing press as defined in claim 12 wherein the plate cylinder, blanket cylinder, impression cylinder, support means and inking or coating apparatus form a first printing unit, the printing press having a second printing unit including a plate cylinder, a blanket cylinder and an impression cylinder in operable combination, further including:

a transfer drum coupled in substrate transfer relation with the impression cylinder of the first printing unit and in substrate transfer relation with the impression cylinder of the second printing unit;

a first dryer mounted adjacent the impression cylinder of the first printing unit for discharging heated air onto a freshly printed or coated substrate while the substrate is in contact with the impression cylinder of the first printing unit;

a second dryer mounted adjacent the transfer drum for discharging heated air onto a freshly printed or coated substrate after it has been transferred from the impression cylinder of the first printing unit and while it is in contact with the transfer cylinder; and,

a third dryer disposed adjacent the impression cylinder of the second printing unit for discharging heated air onto a freshly printed or coated substrate after it has been transferred from the transfer drum and while it is in contact with the impression cylinder of the second printing unit.

18. The invention as defined in claim 12 wherein the inking or coating apparatus includes:

first cradle means for supporting the first applicator roller for engagement with the plate when the inking or coating apparatus is in the operative position; and,

second cradle means for supporting the second applicator roller for engagement with the blanket when the inking or coating apparatus is in the operative position.

19. The invention as defined in claim 12, said support means comprising:

first and second pivot means mounted on the first and second side frame members, respectively.

20. The invention as defined in claim 12, further comprising:

a power actuator pivotally coupled to the inking or coating apparatus, the power actuator having a power transfer arm which is selectively extendable or retractable; and,

apparatus coupled to the power transfer arm and to the inking or coating apparatus for converting extension or retraction movement of the power transfer arm into pivotal movement of the inking or coating apparatus relative to the printing unit.

21. The invention as defined in claim 12 further comprising:

a bell crank plate having a first end portion coupled to the inking or coating apparatus and having a second end portion for engaging a stop member; and,

a stop member secured to the inking or coating apparatus for engaging the second end portion of the bell crank plate.

22. The invention as defined in claim 1 or 12 wherein the inking or coating apparatus comprises:

the first applicator roller having a resilient transfer surface.

23. A printing press as defined in any one of claims 1 or 12 including:

a supply container for containing a volume of liquid ink or coating material;

circulation means coupled between the supply container and the inking or coating apparatus for inducing the flow of liquid ink or coating material from said supply container to the inking or coating apparatus and for returning liquid ink or coating material from the inking or coating apparatus to the supply container; and,

heat exchanger means coupled to the circulation means for maintaining the temperature of the liquid ink or coating material within a predetermined temperature range.

24. A printing press as defined in any one of the claims 1 or 12 wherein the inking or coating apparatus comprises:

a fountain pan for containing a volume of liquid ink or coating material;

an applicator roller having a metering surface; and,

a pan roller mounted for rotation in the fountain pan and coupled to the applicator roller for transferring ink or coating material from the fountain pan to the applicator roller.

25. A printing press as defined in any one of claims 1 or 12 characterized in that:

a resilient packing is mounted on the blanket cylinder, and a printing plate is mounted on the resilient packing.

26. A printing press as defined in any one of claims 1 or 12 further including means for applying ink or coating material to the first and second applicator rollers, and the inking or coating apparatus is pivotally mounted on the printing unit in a position in which the nip contact point between the applicator rollers and the blanket and plate cylinders is offset with respect to a radius line projecting through the center of the plate cylinder and blanket cylinder to the axis of pivotal motion of the inking or coating apparatus.

* * * * *

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DeMoore [45] **Sep. 6, 1983**

[54] **METHOD AND APPARATUS FOR HANDLING PRINTED SHEET MATERIAL**

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[73] Assignee: Printing Research Corporation, Dallas, Tex.

[21] Appl. No.: 242,715

[22] Filed: Mar. 11, 1981

[51] Int. Cl.[3] B41F 21/00

[52] U.S. Cl. 101/419; 101/422; 101/426; 118/DIG. 15

[58] Field of Search .... 101/42.2, 416 R, 417, 101/418, 419, 426; 29/120, 130, 131, 121.3; 118/DIG. 15

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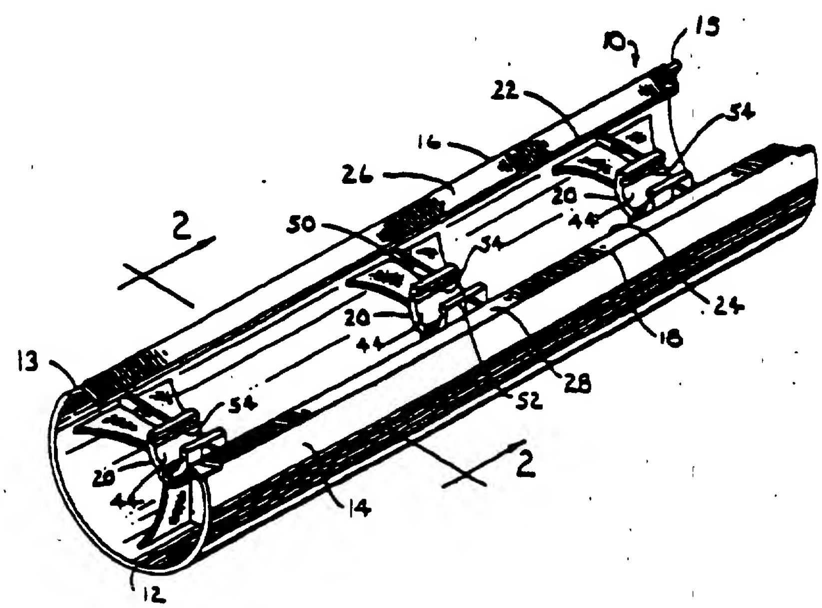
Primary Examiner—Edgar S. Burr
Assistant Examiner—Moshe I. Cohen
Attorney, Agent, or Firm—Fulwider, Patton, Rieber, Lee & Utecht

[57] **ABSTRACT**

A skeleton wheel or cylinder for supporting freshly printed sheet material between printing stations or at the delivery station of a printing press is provided with a loosely retained ink repellent fabric covering for supporting and conveying the sheet material without transfer of wet ink from one sheet to a successive sheet and without smearing the ink or indenting the surface of the sheet material. The circumferential surface of the skeleton cylinder is provided with a coating of a fluorocarbon plastic having a fabric base portion bonded to the surface of the cylinder structure. The low friction properties of the coating permit ease of shuffling movement of the fabric covering and the coating structure provides a cushioning effect to prevent smearing or indenting the sheet material by the fabric cover. The improved cylinder is provided with a plurality of retaining plates slidably fitted in axially spaced hub portions of the cylinder which plates are each locked in place by a set screw. The rim portion of the cylinder includes opposed parallel flanges on which the opposite ends of the fabric covering may be removably retained.

25 Claims, 4 Drawing Figures



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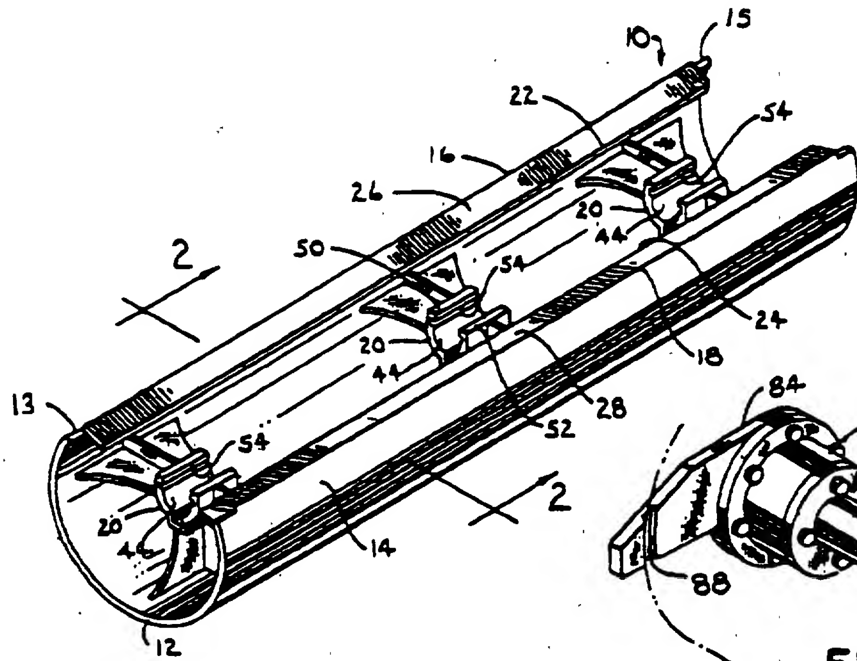

FIG. 1

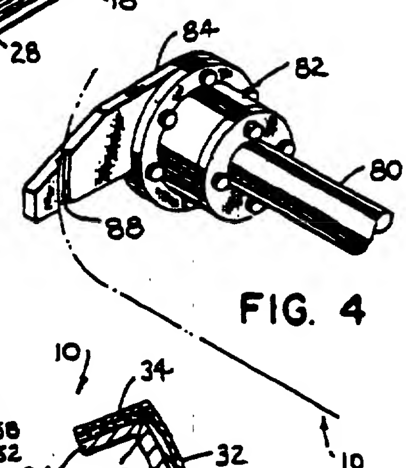

FIG. 4

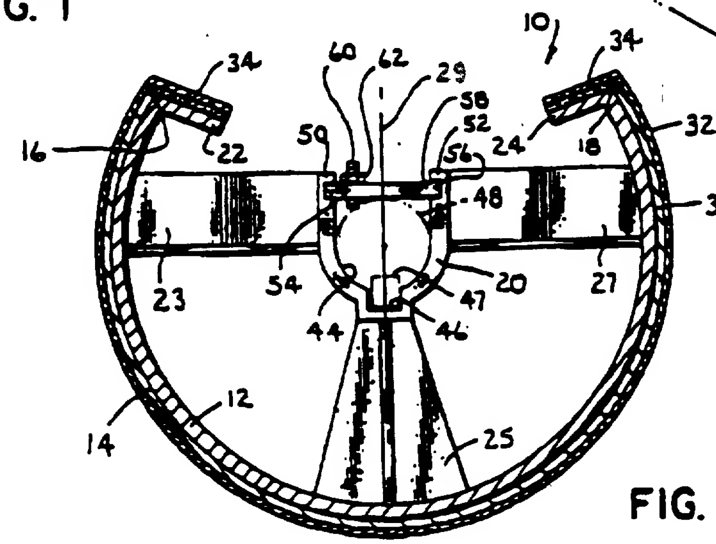

FIG. 2

FIG. 3

METHOD AND APPARATUS FOR HANDLING PRINTED SHEET MATERIAL

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention pertains to a method and apparatus for providing improved support for freshly inked sheet material in a printing press or the like.

2. Background Art

It has been traditional in the art of printing press apparatus and the like to provide devices for supporting freshly inked sheet material when transferring the material from one printing station to another or when handling the sheets as they are delivered from the press wherein said devices comprise wheels of relatively narrow width and characterized by having circumferentially spaced teeth. Such devices are known by the term skeleton wheels in the printing press art. The problems inherent in handling freshly inked printed sheets and the like by skeleton wheels have been longstanding. In order to minimize the contact area between the skeleton wheels and the printed sheet traditional thinking led to the provision of wheels in the form of relatively thin disks having a toothed or serrated circumference. However, these types of wheels have not overcome the problems of smearing and marring the inked surface of the sheet material due to sliding action between the material and the projections or serrations. Moreover, the attempts to minimize the surface area in contact with the sheet material has also resulted in actual indenting or dimpling of the material itself.

Various efforts have been made to overcome the disadvantages of thin disk skeleton wheels. One of the more successful approaches has been completely contrary to the concept of minimizing the surface area. This more recent development is disclosed and claimed in my U.S. Pat. No. 3,791,644 wherein I provide for a substantially cylindrical drum or roller coated with an improved ink repellent surface comprising a layer of polytetrafluoroethylene. Although this improved skeleton wheel has been commercially successful, with continuous use such as is common in many commercial printing operations, there is over a period of time a slight accumulation of ink on the surface of the wheel.

In high speed commercial printing equipment, for example, it has been determined that in order to provide satisfactory printing quality the surface of the coated wheel must be washed relatively frequently with a solvent to remove any ink accumulation. Moreover, it has also been determined that the TFE coated wheels do not provide a cushioning effect which is important for the tightly stretched sheet material as it engages and is supported by the skeleton wheel.

In accordance with the present invention the problems with the prior art thin disk and other type skeleton wheel concepts have been overcome with a skeleton wheel of relatively great width and with an improved ink repellent and supportive structure which may be used in conjunction with the teaching of U.S. Pat. No. 3,791,644 as well as further improvements which I have made in support and handling apparatus for handling freshly inked sheet material.

SUMMARY OF THE INVENTION

The present invention provides an improved method for handling sheet material which has been freshly inked or printed on at least one side wherein the sheet

material is supported by a cylindrical roller or skeleton wheel which has mounted on a cylindrical surface thereof a relatively loose woven fabric or the like. In accordance with one aspect of the present invention there is provided a method for handling freshly printed sheet material in a printing press delivery apparatus or the like wherein a cylindrical roller or skeleton wheel has mounted on the support surface of the wheel a woven fabric of cotton or the like and which is relatively loosely supported on the support surface of the wheel. In accordance with another aspect of the present invention there is provided a method of supporting freshly printed sheet material or the like by means of a cylindrical skeleton wheel or roller having a support surface for a relatively lightweight fabric which is provided by a liquid repellent material of low friction characteristics such as one of the fluoroplastics or the like.

In accordance with another aspect of the present invention there is provided an improved skeleton wheel or roller for a printing press which includes a fabric covered supporting surface for engaging freshly printed sheet material or the like. In a preferred embodiment of the present invention the fabric covering for the skeleton wheel or roller comprises a lightweight cotton fabric or the like treated with a suitable liquid repellant. The fabric is relatively loosely supported on the surface of the cylinder or wheel to accommodate any slight relative movement between the sheet material and the skeleton wheel without marring the freshly inked surface or damaging the sheet material itself. The improved support roller or skeleton wheel of the present invention also contemplates a supporting surface for the fabric covering which may include a low friction fluoropolymer layer.

In accordance with another aspect of the improved skeleton wheel of the present invention the cylindrical support surface for the fabric covering may comprise a coated or impregnated fabric bonded to the cylindrical wheel surface and forming a supporting surface for the loosely secured fabric covering which is directly engageable with the sheet material.

The present invention provides a substantially improved yet simple and reliable handling apparatus and method in the form of a skeleton wheel for printing equipment and the like which is adapted to support sheet material including freshly inked surfaces thereof, without smearing or marking the printed surface and without damaging the sheet material itself. The improved fabric covered skeleton wheel of the present invention is easily installed on a printing press and the fabric covering is easily removed for cleaning or replacement as needed. Those skilled in the art will recognize these advantages as well as other superior features of the present invention upon reading the detailed description which follows in conjunction with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of the improved skeleton wheel of the present invention before application of the coating and fabric covering.

FIG. 2 is a detail section view taken along the line 2—2 of FIG. 1 showing the layers of materials covering the circumferential surface of the wheel;

FIG. 3 is a plan view of a piece of fabric covering adapted for mounting on the skeleton wheel of the present invention; and

FIG. 4 is a detailed perspective view of a portion of a press adapted to use the skeleton wheel of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The improved method and apparatus for handling sheet material in accordance with the present invention is used in a preferred form on high speed printing equipment of the type used, for example, in off-set printing. Such equipment may include one or more support rollers or wheels for handling the sheet material between printing stages and upon delivery of the printed material to a discharge magazine or stack. The particular location of the improved skeleton wheel or roller of the present invention in a typical printing press is believed to be readily understandable to those skilled in the art. Accordingly, a detailed description of the printing press is not believed to be necessary to a complete understanding of the present invention. In any case, reference may be made to my earlier U.S. Pat. No. 3,791,644 which discloses details regarding the location and function of a skeleton wheel for a typical multistation printing press. The present invention may, of course, be utilized with printing presses having any number of printing and delivery stations.

Referring to FIG. 1 of the drawings there is illustrated an elongated member or skeleton wheel generally designated by the numeral 10 comprising the improved skeleton wheel or roller in accordance with the present invention. The skeleton wheel 10 is characterized by a partial cylindrical rim portion 12 which is adapted to be mounted on a press adjacent apparatus, not shown, such as delivery grippers or the like. Accordingly, the outer cylindrical surface 14 of the rim portion 12 has an opening extending the axial width of the skeleton wheel defined by leading and trailing edges 16 and 18, respectively. The skeleton wheel 12 includes a plurality of spaced apart hub portions 20 which may be integrally formed with the rim 12 to comprise a one piece integral casting of aluminum, for example. The hub portions 20 are connected to the rim portion 12 by webs 23, 25 and 27 and are adapted to provide for supporting the skeleton wheel rigidly secured for rotation on a shaft on a printing press in a manner similar to the mounting arrangement disclosed in U.S. Pat. No. 3,791,644 or by an improved arrangement to be discussed herein. As shown in FIG. 1, the skeleton wheel 10 includes opposed elongated integral flange portions 22 and 24 which extend generally inwardly from the surface 14 of the rim 12. The flange portions 22 and 24 include elongated flat surfaces 26 and 28 provided for a purpose to be described further herein.

Referring now to FIG. 2 of the drawings there is illustrated in detail the improved surface construction of the skeleton wheel of the present invention including the fabric covering providing supporting contact with the printed side of a piece of sheet material while conveying the sheet toward a printing station or toward the press delivery magazine. Although the fluoroplastic covered skeleton wheel disclosed in my previous patent provided improvements in handling freshly inked sheet material I have discovered that, unexpectedly, the provision of a layer of fabric on the supporting surface of the skeleton wheel and rather loosely secured thereto further enhances the ability of the skeleton wheel to support and convey successive sheets of printed material with wet ink thereon without transfering the wet ink from a previous sheet to a successive sheet and without marring or depressing the surface of the paper. In accordance with the present invention it has been determined that a woven fabric, preferably cotton, of a relatively loose weave on the order of what is commonly known as gauze has produced the unexpected improvement in a method and apparatus for handling printed material that has wet ink on the surface thereof as it passes over and is supported by the skeleton cylinder. A suitable fabric in accordance with the present invention and illustrated in the embodiment of FIG. 3 comprises a loosely woven, lightweight cotton material such as gauze. A cloth having a forty count or forty mesh, such as the piece of fabric 32 illustrated in FIGS. 2 and 3, treated in accordance with the present invention and attached to the surfaces of the flanges 22 and 24 in a suitable manner has produced the unexpected improvement in the handling of printed sheet material in printing presses and the like. The piece of fabric 32 is preferably of rectangular shape dimensioned to completely cover the outer cylindrical surface of the rim 12.

A preferred method of preparing the fabric piece 32 in accordance with the present invention involves washing the fabric in water in the presence of a suitable fabric softener dissolved therein in rather liberal quantities. One suitable fabric softener which has been used in preparation of the fabric piece 32 is manufactured under the trademark "DOWNY" and, in the washing process, two to three times the normal recommended quantity of softener has been used for washing the fabric in plain water. After washing the fabric piece 32 and allowing same to dry a suitable fabric protector is applied to enhance the liquid repellancy characteristics of the material. A preferred type of fabric protector is manufactured under the trademark SCOTCHGARD by the 3M Manufacturing Company, Minneapolis, Minn. as their Part No. FC4101-C-12. Moreover, it has been determined that even though some ink will accumulate on the surface of the fabric threads over an extended period of operating time the provision of the fabric protector permits the occasional rubbing or agitation of the fabric by the press operator in place on the skeleton cylinder to break loose and remove dried ink particles or crystals which have accumulated on the fabric without requiring removal and washing of the fabric piece.

Referring to FIG. 2 a suitable method of attaching the fabric piece 32 to the outer surface of the rim 12 is by a double sided adhesive tape strip 32 disposed on and extending the length of each of the respective surfaces 26 and 28. Another suitable method of attaching the fabric piece 32 would be by the use of fastener strips such as of the type made under the trademark VELCRO. Those skilled in the art will appreciate that other means may be provided for attaching the fabric piece 32 to the flanges 22 and 24, however, the abovementioned methods provide for quickly attaching and removing the fabric piece 32 with respect to the wheel 10.

An important aspect of the present invention concerns the type of fabric support surface provided on the rim 12 and overlying the surface 14. The improved surface is preferably of a low coefficient of friction such as may be provided by coating the metal surface 14 of the cylinder with a fluoroplastic as taught by U.S. Pat. No. 3,791,644. Although the combination of the coating described in the abovementioned patent together with the fabric member 32 attached thereover provides suitable performance it has been discovered that the fabric covering for the skeleton wheel 10 per-

forms somewhat better in eliminating any marring or depressions in the surface of the sheet material by the application of a coating including a fabric reinforcement as will be described herein.

Referring to FIG. 2 the rim portion 12 of the skeleton wheel 10 is provided with a coating 35 comprising a fluorocarbon composite coating material applied in one or more coats over a fabric base which is adhesively bonded to the cylindrical circumferential 14 of the rim portion 12. It is believed that the provision of the fabric base for the coating such as described herein provides a cushioning effect for the fabric piece 32 which is applied over the coating 35 and which reduces the tendency for the fabric piece 32 to indent or form depressions in the surface of the sheet material as well as substantially preventing the transfer of wet ink from one sheet to a successive sheet.

In a preferred method of preparing and forming the coating 35 a suitable piece of fabric such as cotton canvas of approximately 0.022 inch nominal thickness and having a waterproofing applied to one side thereof is cut somewhat oversize, approximately 4 to 5 inches all around, from the actual size required to cover the entire surface 14. The fabric is then suitably tacked to a substantially flat and smooth preparation surface to prevent movement or shrinkage while a first coat of the fluoropolymer or fluorocarbon material is applied thereto. A preferred composition for providing the coating 35 is a liquid fluoropolymer coating made under the trademark XYLAN by the Whitford Corporation, Westchester, Pa. A satisfactory coating material of the type referred to hereinabove is XYLAN 1010 composite type coating material which is self curing at room temperature.

After the aforedescribed fabric base is temporarily fastened to a suitable surface with the waterproof side facing said surface the non waterproofed side of the fabric is sanded lightly with a 220 grit paper to bring out the nap of the fabric. One coat of XYLAN 1010 coating material is then applied to the aforedescribed fabric and allowed to cure at room temperature. Once the first coating layer has been allowed to dry the coated fabric is removed from the temporary preparation surface and bonded to the surface 14 of the rim 12 using a suitable adhesive such as a contact cement made by 3M Corporation. The surface of the coated fabric piece which is applied to the surface of the rim portion 12 is the waterproofed side. The surface 14 is normally prepared for application of the adhesive in the prescribed manner to be clean and dry. Care should be taken to roll out the coated fabric piece of the coating 35 when it is applied to the surface 14 to prevent entrapment of air bubbles or the like.

After the adhesive is allowed to dry the fabric is trimmed to size and additional coatings of the fluoropolymer are applied and allowed to dry between coats. A suitable coating 35 is formed by the application of three additional layers of XYLAN 1010 coating material after the fabric base has been bonded to the surface of the rim 12. The surface formed by the coating 35 is preferably sanded lightly between each coat of fluoropolymer with, for example, 400 grit finishing paper.

The preparation of the surface coating 35 as aforedescribed provides a substantially glazed surface with a low coefficient of friction which is ink repellent and also provides for ease of movement of the fabric piece 32 when the same is attached to the cylinder 10. Although, in accordance with the present invention, the fluoropolymer coating described is particularly advantageous it is contemplated that other low friction plastic coatings may be applied to the aforementioned fabric base to produce a suitable surface for the fabric member 32. The particular fluorocarbon type coating of the general class of coatings referred to herein has produced the unexpected improvement of reducing ink transfer of one sheet to another in high speed printing equipment and has also, in combination with the fabric member 32, reduced depressing or indenting of the paper surface of the sheets. After the coating 35 has been prepared the fabric piece 32 is applied to the flanges 22 and 24 by the adhesive stripes 34 or other suitable fastening means loose enough so that with normal finger pressure the fabric may be locally moved over the surface of the coating 35 in all directions at least one eighth inch to one inch. Moreover, in printing presses in which the drive train has become loose with wear, for example, relative movement between the press impression cylinder and the skeleton wheel will not result in smearing of the ink thanks to the movability of the fabric covering with respect to the cylinder rim.

The improved skeleton wheel or cylinder of the present invention also includes improved means for attaching the wheel to the associated driving shaft of the printing press. Referring to FIGS. 1 and 2, the spaced apart hub portions 20 are provided with semi-cylindrical support surfaces 44 which are intersected by a suitable keyway 46 in which may be disposed a key 47 for drivingly engaging the skeleton wheel 12 with a press drive shaft indicated by the numeral 48 in FIG. 2. The hub portions 20 are provided with an improved retention means for mounting the skeleton wheel 10 on the shaft 48. The spaced apart hub portions 20 are each formed with integral axially extending bosses 50 and 52 spaced apart sufficiently to allow the skeleton wheel to be slipped radially on and off of the shaft 48. The bosses 50 and 52 are provided with opposed axially extending slots 54 and 56, respectively, which are aligned with each other to permit the insertion of a retaining plate 58. The retaining plate 58 is preferably of a length slightly less than the span between the bottoms of the grooves 54 and 56 so that the plate fits snugly in the respective grooves. The plate is preferably of a width equal to the axial length of the bosses 50 and 52. As shown in FIG. 2, the retaining plate 58 is provided with a socket head lock screw 60 threadedly engaged with the retaining plate and provided with a suitable lock nut 62. The lock screw 60 is offset from the center line which bisects the opening between the spaced apart bosses 50 and 52.

The lock screws 60 are adapted to be tightened to engage the periphery of the shaft 48 to prevent axial sliding of the skeleton wheel 10 with respect to the shaft and to permit minor radial adjustment of the skeleton wheel with respect to the shaft. When installing the cylinder 10 on the shaft 48 or removing the cylinder from the shaft the improved retaining plate 58 may be inserted in and removed from the respective grooves 54 and 56 followed by tightening or loosening of the screws 60, as the case may be, to provide a simplified arrangement for mounting and removing the cylinder with respect to the associated press drive shaft. The leading and trailing edges 16 and 18 are advantageously disposed substantially equidistant from the centerline 29 so that in some applications the skeleton wheel 10 can be turned end for end when the leading edge becomes worn or damaged.

Another feature of the present invention which has permitted improved retrofitting of a skeleton wheel such as the wheel 10 on certain types of press equipment is provided by the axially extending portions 13 and 15 of the rim 12 which extend in opposite directions respectively from the flanges 22 and 24. In certain types of presses such as a model TP-38A made by the Miller Printing Equipment Companpy one or more stationary side plates are located adjacent ends of the skeleton wheel or cylinder and are positioned such that certain lengths of printed material will overlap the side plates and will be disfigured while being conveyed past the plates under the support of the skeleton wheel because the wheel cannot be moved axially on the shaft to the non printed area of the sheet. However, with the improved skeleton cylinder 10 having the axially extending rim portions 13 and 15, a suitable annular groove may be cut in the side plates to accommodate the axial length of the wheel 10 to thereby substantially support the full length of the sheet material as it is conveyed by the wheel.

Referring to FIG. 4 there is shown a detail view of a portion of a skeleton wheel support shaft 80 similar to the shaft 48. The shaft 80 is supported in a bearing assembly 82 which is bolted to a support assembly including a side plate member 84. The plate 84 is stationary and prevents the use of a skeleton wheel or cylinder having a length substantially equal to the length of the sheet and providing adequate support thereof. However, by forming the annular groove 88 to have radial and axial dimensions with respect to the longitudinal centerline of the shaft 80 sufficient to clear the axial end portions 13 or 15 of the rim 12, the cylinder 10 may be installed on a press equipped as shown to support substantially the entire length of the sheet material.

Those skilled in the art will appreciate that various modifications to the method and apparatus of the present invention may be made without departing from the scope of the invention as defined in the appended claims.

What I claim is:

1. A method for supporting and conveying sheet material which has been freshly printed and discharged from a printing press or the like without marring the freshly inked surface, comprising the steps of:
   providing a skeleton wheel having a sheet supporting surface thereon;
   providing a piece of fabric;
   attaching said piece of fabric to said skeleton wheel to be disposed over at least that part of said surface which supports said sheet material, said piece of fabric being attached relatively loosely to permit and accomodate slight movement between the fabric and the skeleton wheel when the sheet material is supported and conveyed by skeleton wheel and
   rotating said skeleton wheel to engage successive sheets of said sheet material in supportive and conveying relationship thereto by said piece of fabric without marring said freshly printed surface.

2. The method as set forth in claim 1 together with the steps of:
   providing said piece of fabric of woven cloth.

3. The method set forth in claim 2 wherein:
   said cloth is provided of woven substantially gauzelike cotton material on the order of about forty mesh.

4. The method set forth in claim 2 or 3 together with the steps of:
   treating said fabric with a liquid repellent prior to attaching said piece of fabric to said skeleton wheel.

5. The method set forth in claim 4 together with the steps of treating said fabric with a fabric softening material prior to treating said fabric with liquid repellent.

6. The method set forth in claim 1 together with the steps of:
   providing an ink repellent coating on said surface for supporting said piece of fabric.

7. The method set forth in claim 6 wherein:
   said coating includes a polytetrafluoroethylene.

8. The method set forth in claim 6 together with the step of:
   providing a fabric base portion for said coating.

9. In a skeleton wheel for supporting and transferring a freshly printed sheet from a printing station on a printing press or the like without marring the freshly inked surface;
   a generally cylindrical rim segment having a generally cylindrical support surface formed thereon; and
   a fabric covering disposed over at least a part of said support surface for supportively engaging one side of said sheet during the transfer thereof; and
   means for securing said fabric covering to extend relatively loosely over said support surface to permit and accomodate slight movement between the fabric covering and said support surface when the printed sheet is supported and transferred by the skeleton wheel so that the freshly printed sheet is not marred.

10. The invention set forth in claim 9 wherein:
   said fabric covering comprises woven substantially gauzelike cotton material on the order of about forty mesh.

11. The invention set forth in claim 10 wherein:
   said fabric covering is treated with a liquid repellent.

12. The invention set forth in claim 10 wherein said fabric covering is treated with a fabric softening agent.

13. The invention set forth in claim 9 wherein:
   said generally cylindrical support surface is delimited in a circumferential direction by opposed elongated flanges, and said skeleton wheel includes means for removably attaching said fabric covering to said wheel along said flanges.

14. The invention set forth in claim 13 wherein:
   said means for attaching includes an adhesive strip mounted on said flanges.

15. The invention set forth in claim 13 wherein:
   said rim segment extends axially beyond said flanges for supporting substantially the entire length of said sheet.

16. The invention set forth in claim 9 or 13 wherein:
   said surface includes a low friction coating thereon.

17. The invention set forth in claim 16 wherein:
   said coating comprises at least one layer comprising polytetrafluoroethylene.

18. The invention set forth in claim 16 wherein:
   said coating includes a fabric layer on which at least one layer of a fluoropolymer coating is applied.

19. The invention set forth in claim 18 wherein:
   said fabric layer is a woven canvas.

20. A method of supporting and conveying sheet material which has been freshly inked and discharged

from a printing press or the like without marring the freshly inked surface, comprising the steps of:

forming an ink repellent coating on a sheet supporting surface of a skeleton wheel;

treating a piece of fabric with a fabric softening agent;

treating the piece of fabric with a liquid repellent subsequent to treatment with said fabric softening agent;

attaching the piece of fabric to the skeleton wheel to cover the sheet supporting surface, said attaching step including mounting the piece of fabric relatively loosely over the sheet supporting surface such that the piece of fabric is capable of accommodating relative movement between the sheet material and the sheet supporting surface substantially without marring or damaging the freshly inked sheet material; and

rotating the skeleton wheel to engage successive sheets of the sheet material in supportive and conveying relation with the piece of fabric.

21. The method of claim 20 wherein said step of forming an ink repellent coating comprises the steps of applying an ink repellent agent to a fabric base portion and securing the fabric base portion to the skeleton wheel.

22. The method of claim 20 wherein the skeleton wheel sheet supporting surface has a generally cylindrical shape interrupted by an opening extending the axial width of the skeleton wheel, said opening being bounded by a pair of generally radially inwardly directed flanges, and wherein said attaching step comprises wrapping the piece of fabric about the sheet supporting surface and securing opposite ends of the piece of fabric respectively to the flanges.

23. A skeleton wheel for supporting and transferring a freshly inked printed sheet from a printing station of a printing press or the like without marring the freshly inked surface, comprising:

a wheel member having a generally cylindrical sheet supporting surface with an ink repellent coating formed thereon;

a fabric covering comprising a woven cloth treated with a fabric softening agent and then treated with a liquid repellent agent; and

means for attaching said fabric covering relatively loosely to said wheel member to cover said sheet supporting surface such that said fabric covering is capable of accommodating sufficient relative movements between a printed sheet supported and transferred thereby and said sheet supporting surface substantially without marring or damaging the printed sheet.

24. The skeleton wheel of claim 23 wherein said ink repellent coating comprises a fabric base portion with at least one layer of a fluoropolymer material applied thereon.

25. The skeleton wheel of claim 24 wherein said fabric base portion is formed from a canvas sheet.

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(54) Retractable inking/coating apparatus having ferris movement between printing units

(57) A retractable in-line inking/coating apparatus (10) selectively applies either spot or overall ink/coating material to a blanket (B) or flexographic plate (P) on a blanket cylinder (34), or spot or overall ink/coating to a flexographic printing plate (P) on a plate cylinder (32) in a rotary offset printing press (12). The inking/coating apparatus is pivotally mounted on a printing unit (22, 24, 26, 28) or dedicated coating unit, and is extendable into and retractable out of an operative inking/coating position by a carriage assembly (58) which is pivotally coupled to the printing unit. Because of the pivotal support provided by a cantilevered support arm (88, 90), the inking/coating apparatus is extended and retracted through a Ferris wheel arc between adjacent printing units.

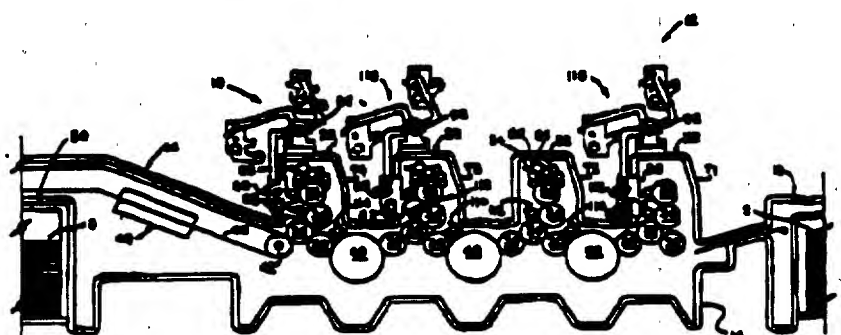

FIG. 1

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EUROPEAN SEARCH REPORT

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DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X Y	US 4 841 903 A (BIRD) * abstract; claims; figure 1 *	1,15-17 4-6,8,9,13	B41F31/30 B41F5/24 B41F23/08
X	US 5 107 790 A (SLIKER ET AL.) * abstract; claim 1; figures * * column 2, line 9 - line 22 *	1,18	
Y	US 5 335 596 A (DEMOORE ET AL.) * abstract; figures 1-4 * * column 7, line 32 - line 58 *	4,5,8,9	
Y	US 4 617 865 A (SWITALL) * abstract; figures 1-3 * * column 6, line 9 - line 42 *	6	
Y	US 4 825 804 A (DIRICO ET AL.) * abstract; figures 2,3 * * column 3, line 10 - line 21 *	13	TECHNICAL FIELDS SEARCHED (Int.Cl.6)
A	EP 0 647 524 A (DEMOORE) * abstract; figures 1,2,5 * * column 4, line 32 - line 40 *	15-22	B41F
A	PAPIER + KUNSTSTOFF VERARBEITER, vol. 26, no. 6, 1 June 1991, page 129 XP000232825 "LACKIER-AGGREGAT FUER SPEEDMASTER-MASCHINEN"	1	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	20 March 1997	Helpiö, T

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
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T : theory or principle underlying the invention
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(54) **Retractable inking/coating apparatus having ferris movement between printing units**

(57) A retractable in-line inking/coating apparatus (10) selectively applies either spot or overall ink/coating material to a blanket (B) or flexographic plate (P) on a blanket cylinder (34), or spot or overall ink/coating to a flexographic printing plate (P) on a plate cylinder (32) in a rotary offset printing press (12). The inking/coating apparatus is pivotally mounted on a printing unit (22, 24, 26, 28) or dedicated coating unit, and is extendable into and retractable out of an operative inking/coating position by a carriage assembly (58) which is pivotally coupled to the printing unit. Because of the pivotal support provided by a cantilevered support arm (88, 90), the inking/coating apparatus is extended and retracted through a Ferris wheel arc between adjacent printing units.

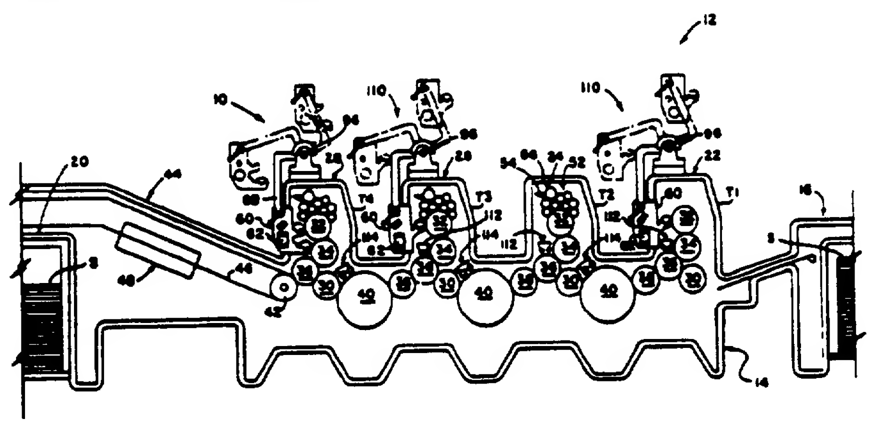

FIG 1

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Description

This invention relates to sheet-fed or web-fed, rotary offset or flexographic printing presses, and more particularly, to a new and improved inking/coating apparatus for the in-line application of printing inks or protective or decorative coatings to sheet or web substrates.

Conventional sheet-fed, rotary offset printing presses typically include one or more printing units through which individual sheets are fed and printed with wet ink. Since the inks used with rotary offset printing presses typically remain wet and tacky for some time after printing, special precautions must be taken to insure that the freshly printed sheets are not marked or smeared as the sheets are transferred from one printing unit to another, and while being conveyed to the sheet delivery stacker. The printed surface of the freshly printed sheet dries relatively slowly and can be smeared during subsequent transfer between printing units. In order to reduce smearing and offsetting, spray powder is applied on the printed sheet.

In some printing applications, offset and smearing are prevented by applying a protective and/or decorative coating over all or a portion of the freshly printed sheets. Various arrangements have been proposed for applying the protective or decorative coating as an in-line operation by using the last printing unit of the press as the coating application unit. However, when such in-line coating is performed, the last printing unit cannot be used to apply ink to the sheets, and can only be used for the coating operation. Thus, while coating with these types of in-line coating apparatus, the press loses the capability of printing its full range of colors since the last printing unit is converted to a coating unit.

It will be appreciated that the time required to reconfigure a press for coating or non-coating is non-productive and costly. Accordingly, there is a need for an in-line coating apparatus that minimizes the time to clean-up from one printing run and set-up and run the next job. Where consecutive jobs require the same type of coating, particularly blanket coating, it may not be necessary to clean-up the coater between jobs. However, the coating material cannot be allowed to dry on the rollers. Therefore, especially when switching from blanket to spot coating or vice versa, or if there is a delay between jobs, it is necessary to wash-up the coater after each job is completed.

In addition, coater wash-up is necessary when switching between different coating compositions, such as aqueous and ultra violet (UV) curable coatings. Such coating materials are not interchangeable, and consequently, the coater must be washed between applications of different coating media.

The foregoing limitations are overcome, according to the present invention, by a retractable, in-line inking/coating apparatus which is mounted on a printing unit for pivotal, Ferris wheel movement between an operative inking/coating position and a retracted, overhead idle position. The inking/coating apparatus includes an applicator head which, is positioned in alignment with either the plate cylinder or the blanket cylinder by a carriage assembly which includes a cantilevered support arm. The support arm is pivotally coupled between the inking/coating head and the printing unit tower. This cantilevered, pivotal mounting arrangement allows the inking/coating unit to be used between two printing units, as well as on the last printing unit of the press.

In the preferred embodiment, the applicator head includes vertically spaced pairs of cradle members with one cradle pair being adapted for supporting a metal or ceramic coating roller in alignment with a blanket cylinder, and the other cradle pair supporting a resilient anilox coating roller in alignment with the plate cylinder, respectively, when the carriage assembly is in the operative position. Because of the cantilevered, pivotal support provided by the support arm, the applicator head can be lifted and lowered through an arc, similar to Ferris wheel movement, in the limited space between adjacent printing units. When fully retracted, the applicator head and carriage assembly are lifted to an elevated, retracted overhead position, preferably an overhead position overlying the printing unit tower, thus providing complete access to the interstation space and the printing unit cylinders without causing the printing unit to lose its printing capability. The inking/coating applicator roller of the applicator head can be inspected, cleaned or replaced and the doctor blade assembly can be washed-up automatically while the inking/coating apparatus is in the retracted position.

When the inking/coating apparatus is used in combination with a flexographic printing plate and aqueous ink or aqueous coating, the water component of the aqueous ink or coating on the freshly printed sheet is evaporated by a high velocity, hot air interstation dryer and a high volume heat and moisture extractor assembly so that the freshly printed ink or coating is completely dry before the sheet is printed on the next printing unit. This quick drying flexographic printing/coating arrangement permits a base coat of ink, for example opaque white or metallic ink (gold, silver or other metallics) to be applied in the first printing unit, and then overprinted by a lithographic process on the next printing unit.

Exemplary embodiments of the present invention are illustrated in the drawing figures wherein:

FIGURE 1 is a schematic side elevational view of a sheet-fed, rotary offset printing press having inking/coating apparatus embodying the present invention;

FIGURE 2 is a perspective view of the printing press of FIGURE 1 in which a dual head inking/coating apparatus is in the operative coating position and a single head coater is in a retracted, overhead position;

FIGURE 3 is an enlarged simplified perspective view showing one side of the single head ink-

dampening rollers (not illustrated) will be in direct engagement with the lithographic plate P, but are not used in combination with the flexographic plate of printing unit 22.

Referring now to FIGURE 4, FIGURE 5 and FIGURE 6, the in-line inking/coating apparatus 10 includes a carriage assembly 58 which supports an applicator head 60. The applicator head 60 includes a hydraulic motor 62, a lower gear train 64, an upper gear train 65, an applicator roller 66 and a doctor blade assembly 68. The external peripheral surface of the applicator roller 66 is inserted into wetting contact with liquid coating material or ink contained in a reservoir 70. The reservoir 70 is continuously supplied with ink or coating which is circulated through the reservoir 70 from an off-press source by a pump (not illustrated). The hydraulic motor 62 drives the applicator roller 66 synchronously with the plate cylinder 32 and the blanket cylinder 34 in response to an RPM control signal from the press drive (not illustrated) and a feedback signal developed by a tachometer 72. While a hydraulic drive motor is preferred, an electric drive motor can be used.

The applicator roller 66 is preferably a fluid metering anilox roller which transfers measured amounts of printing ink or coating material onto the printing plate or blanket. The surface of an anilox roller is engraved with an array of closely spaced, shallow depressions referred as "cells". Ink or coating material from the reservoir 70 flows into the cells as the anilox roller turns through the reservoir. The transfer surface of the anilox roller is scraped with a doctor blade 73 to remove excess ink or coating. The ink or coating remaining on the anilox roller is the measured amounts contained within the cells.

The applicator roller 66 is cylindrical and may be constructed in various diameters and lengths, containing cells of various sizes and shapes. The volumetric capacity of an anilox roller is established during manufacturing and is dependent upon the selection of cell size, shape and number of cells per unit area. Depending upon the intended application, the cell pattern may be fine (many small cells per unit area) or coarse (fewer larger cells per unit area).

By applying the ink or coating material through the inking/coating applicator head 60, more ink or coating material can be delivered to the sheet S as compared with the inking roller train of a lithographic printing unit. Moreover, color intensity is stronger and more brilliant because the flexographic ink is applied at a much larger film thickness than can be applied by the lithographic process and is not diluted by dampening solution.

The inking/coating applicator head 60 includes side frame members 74, 76 that support the applicator roller 66, gear train 64, gear train 65, doctor blade assembly 68 and the drive motor 62. The applicator roller 66 is supported at opposite ends on a lower cradle formed by a pair of end plates 78, 80 which hold the applicator roller 66 in parallel alignment with the blanket cylinder 34 (FIGURE 5). The side frames 74, 76 are also provided with an upper cradle formed by a pair of side plates 82, 84 which are vertically spaced with respect to the lower side plates 78, 80. Each cradle has a pair of sockets 79, 81 and 83, 85, respectively, for holding the applicator roller 66 for spot coating or inking engagement against the plate P of the plate cylinder 32 (FIGURE 4) or the blanket B of the blanket cylinder 34.

Preferably, the applicator roller 66 for the upper cradle (plate) position is an anilox roller having a resilient transfer surface. In the dual cradle arrangement, the press operator can quickly change over from blanket inking/coating and plate inking/coating with minimum press down time, since it is only necessary to remove and reposition or replace the applicator roller 66, and wash-up the doctor blade assembly if changing from ink to coating or vice versa. The capability to selectively operate in either the flexographic mode or the lithographic mode and to print or coat from either the plate or blanket position is referred to herein as the "LITHOFLEX" process.

Referring again to FIGURE 2 and FIGURE 3, the applicator head 60 is supported by the carriage assembly 58 in a cantilevered, pivotal arrangement which allows the dual cradle inking/coating apparatus 10 and a single cradle inking/coating apparatus 110 to be used between any two adjacent printing units, as well as used on the first and last printing units of the press. This is made possible by a pair of cantilevered support arms 88, 90 that are pivotally coupled to the side plates 74, 76, respectively, on a pivot shaft 77. Each support arm has a hub portion 88A, 90A, respectively, and an elongated shank portion 88B, 90B, respectively.

The cantilevered support arms are pivotally mounted on the printing tower by pivot blocks 92, 94, respectively. The hub portions 88A, 90A are journalled for rotation on pivot shafts 96, 98, respectively. The pivot blocks 92, 94 are securely fastened to the tower 14D, so that the carriage assembly 86 is pivotally suspended from the pivot shafts 96, 98 in a cantilevered Ferris support arrangement. The shank portions 88B, 90B are pivotally coupled to the pivot shaft 77, so that the carriage assembly 58 and the applicator head 60 are capable of independent rotation with respect to each other and with respect to the pivot shaft 77. By this arrangement, the applicator head 60 is pivotally suspended from the pivot shaft 77, and remains in an upright orientation as the support arms rotate from the operative position to the fully retracted position, and vice versa.

Thus, the cradles 78, 80 and 82, 84 position the applicator roller 66 in vertical and horizontal alignment with the plate cylinder or blanket cylinder when the applicator head is extended to the operative position, for example as shown in FIGURE 4 and FIGURE 5. Moreover, because of the transverse relationship between the hub portion and shank portion of the support arms, the applicator head 60 and carriage assembly 58 are capable of rotating through a Ferris arc without touching the adjacent printing tower. This makes it possible to install the inking/coating apparatus 10 on any intermedi-

ate printing unit tower (T2, T3), and as well as on the first printing unit tower T1 and the last printing unit tower T4. Additionally, when the inking/coating unit 10 is in the operative position, the lateral projection of the applicator head 60 into the interstation space between printing units is minimized. This assures virtually unrestricted operator access to the interstation space between adjacent printing units when the applicator head is engaged in the operative position, and completely unrestricted access when the carriage assembly 58 is retracted.

Rotation of the carriage assembly 58 is counterclockwise from the retracted, idle position (shown in phantom in FIGURE 1) to the operative position (FIGURE 4 and FIGURE 5) The carriage assembly 58 can be adapted for clockwise rotation from the retracted position to the operative position for engagement of the applicator roller to either the plate or the blanket on the dampener side of the tower, assuming that access to the plate and blanket is not restricted by dampener rollers or the like.

Rotational movement of the support arms 88, 90 is assisted by counterweights 100, 102 which are secured to the support arms, respectively, for concurrent rotation with respect to the pivot blocks 92, 94. With the passive assistance of the counterweights, the press operator can easily move the inking/coating assembly 10 from the engaged operative position as shown in FIGURE 4 to the fully retracted, idle position as shown in phantom in FIGURE 1. Preferably, rotation of the carriage assembly 58 is assisted by a torsion spring, electric motor or hydraulic motor.

The inking/coating apparatus 10 is releasably locked into the operative position as shown in FIGURE 4 by releasable latch couplings 103, 105 that secure the support arms 88, 90 to the press side frames 14, 15, respectively, of the printing unit tower T4 in the operative position. Coating engagement of the applicator roller 66 against the blanket cylinder 34 is produced by power actuators, preferably pneumatic cylinders 104, 106 which have extendable/retractable power transfer arms 104A, 106A, respectively. The pneumatic cylinder 104 is pivotally coupled to the support arm 88 by a pivot linkage 108, and the second pneumatic cylinder 106 is pivotally coupled to the support arm 90 by a pivot linkage 109. In response to actuction of the pneumatic cylinders 104, 106, the power transfer arms are retracted. As the transfer arms retract, the inking/coating head 60 is rotated counterclockwise on the pivot shaft 77, thus moving the applicator roller 66 into coating engagement with the blanket cylinder 34.

The pivot linkage 108 includes a bell crank 111 which is mounted for pivotal movement on a pin 113. The pin 113 is supported by a clevis plate 115 which is attached to the support arm 88. One end of the bell crank is pivotally coupled to the actuator arm 104A, and a cam roller 117 is mounted for rotation on its opposite end.

The cam roller 117 is engagable against an adjustable stop 119 which is rigidly secured to the side plate 74. Counterclockwise shifting of the handle H moves a cam follower 121 into a latch pocket 123 of a receiver block 125 as the cam roller 117 is moved into engagement with the adjustable stop 119 in the interlocked, operative position. Referring to FIGURE 4, FIGURE 5 and FIGURE 6, the receiver block 125 is secured to the delivery side of the printing unit tower by machine screws.

When the plate P goes on impression, power is applied to the pneumatic actuator 104 and the power transfer arm 104A retracts, thus causing the bell crank 111 to rotate counterclockwise about the pin 113. The torque applied by the pneumatic actuator 104 is transmitted to the applicator head 60 through the cam roller 117 and the adjustable stop 119. Counterclockwise movement of the applicator head 60 relative to the support shaft 77 carries the applicator roller 66 into engagement with the plate P.

The adjustable stop 119 has a threaded bolt 119A which is engagable with the cam roller 117. The striking point of engagement is preset so that the applicator roller 66 is properly positioned for engagement with the plate P or blanket B in the operative position when the applicator head 60 is interlocked with the press frame 14 and the printing unit goes on impression.

Referring to FIGURE 5, an inking/coating apparatus 110 having a single head is illustrated. The construction of this alternative embodiment is identical in all respects with the dual head arrangement, with the exception that only a single gear train and a single cradle for holding the applicator roller is provided. In both embodiments, the inking/coating head 60 remains upright as it swings through an arc, comparable to the movement of a Ferris wheel. Because of the upright orientation of the inking/coating head 60 as it moves between the extended and retracted positions, the usual platform spacing between printing unit towers provides adequate clearance to permit extension and retraction of the carriage assembly 58 without interference with operator access to the printing units. This is a significant advantage in that it permits the in-line inking/coating apparatus 10 to operate effectively in the interstation space between any adjacent printing units, and without blocking or obstructing access to the cylinders of the printing units when the inking/coating apparatus is in the retracted position (as indicated in phantom in FIGURE 1).

Moreover, when the in-line inking/coating apparatus is in the fully retracted position, the applicator roller 66 is conveniently positioned on the dampener side of the printing unit for inspection, clean-up or replacement. Additionally, the doctor blade assembly is also conveniently positioned for inspection, removal, adjustment or clean-up. Also, the doctor blade reservoir and coating circulation lines can be cleaned while the press is running as well as when the press has been stopped for change-over from one type of ink or coating material to another.

When the inking/coating apparatus is used for applying an aqueous ink or an aqueous coating material, the water component on the freshly printed sheet S is evaporated by a high velocity, hot air interstation dryer and high volume heat and moisture extractor units 112 and 114, as shown in FIGURE 1, FIGURE 4 and FIGURE 5. The dryer/extractor units 112 and 114 are oriented to direct high velocity heated air onto the freshly printed/coated sheets as they are transferred by the interunit and the intermediate transfer cylinders 36, 40. By this arrangement, the freshly printed aqueous ink or coating material is completely dry before the sheet is overprinted in the next printing unit.

The high velocity, hot air dryer and high performance heat and moisture extractor units 112, 114 utilize high velocity air jets which scrub and break-up the moist air level which clings to the surface of each freshly printed sheet. Within each dryer, high velocity air is heated to a high temperature as it flows across a resistance heating element within an air delivery baffle tube. High velocity jets of hot air are discharged through multiple airflow apertures through an exposure zone Z (FIGURE 4 and FIGURE 5) onto the freshly printed/coated sheet S as it is transferred by the transfer cylinder 36 and intermediate transfer cylinder 40, respectively. Each dryer assembly includes a pair of air delivery dryer heads which are arranged in spaced, side-by-side relation as shown in FIGURE 4 and FIGURE 5.

The high velocity, hot moisture-laden air displaced from each freshly printed sheet is extracted from the dryer exposure zone Z and completely exhausted from the printing unit by the high volume extractors. Each extractor head includes a manifold coupled to the dryer heads and draws the moisture, volatiles and high velocity hot air through a longitudinal gap between the dryer heads. According to this arrangement, each printed sheet is dried before it is run through the next printing unit.

The water-based inks used in flexographic printing dry at a relatively moderate drying temperature provided by the interstation high velocity hot air dryers/extractors 112, 114. Consequently, print quality is substantially improved since the aqueous ink is dried at each printing unit before it enters the next printing unit. Moreover, back-trapping on the blanket of the next printing unit is completely eliminated. This interstation drying arrangement makes it possible to print aqueous inks such as metallic ink and opaque white ink at one printing unit, and then overprint at the next printing unit.

This arrangement also permits the first printing unit to be used as a coater in which an aqueous coating is applied to low grade paper, for example recycled paper, to trap and seal in lint, dust, spray powder and other debris and provide a smoother, durable surface that can be overprinted in the next printing unit. The first down coating seals the surface of the low grade, rough substrate and improves overprinted dot definition while preventing strike-through and show-through. A UV-curable protective and/or decorative coating can be applied over the first down overprinted (aqueous) coating in the last printing unit.

Preferably, the applicator roller 66 is constructed of metal or ceramic when it is used for applying a coating material to the blanket B on the cylinder 34. When the applicator roller 66 is applied to the plate, it is preferably constructed as an anilox roller having a resilient transfer surface for engaging a flexographic printing plate. Suitable resilient roller surface materials include Buna N synthetic rubber and EPDM (terpolymer elastomer).

It will be appreciated that the inking/coating apparatus 10 is capable of applying a wide range of ink types, including fluorescent (Day Glo), pearlescent, metallics (gold, silver and other metallics), glitter, scratch and sniff (micro-encapsulated fragrance), scratch and reveal, luminous, pressure-sensitive adhesives and the like.

The press operator can eliminate the dampener roller assembly altogether, and the inking/coating apparatus 10 can selectively apply aqueous inks and coatings to a flexographic or waterless printing plate and the blanket. Moreover, overprinting of the aqueous inks and coatings can be carried out in the next printing unit since the aqueous inks and coatings are completely dried by the high velocity, hot air interstation dryer and high volume heat and moisture extractor assembly.

The aqueous inks and coatings as used in the present invention contain colored pigments and/or soluble dyes, binders that fix the pigments onto the surface of the printed sheet, and waxes, defoamers and thickeners. Aqueous printing inks predominantly contain water as a solvent, diluent and/or vehicle. The thickeners which are preferred include algonates, starch, cellulose and its derivatives, for example cellulose esters or cellulose ethers and the like. Coloring agents including organic as well as inorganic pigments may be derived from dyes which are insoluble in water. Also, the printing ink may contain water and can be predominantly glycol or the like, with the pigment being bound by an appropriate resin. When metallic inks are printed, the cells of the anilox roller must be appropriately sized to prevent the metal particles from getting stuck within the cells. The cell size is critical, and for metallic gold ink, the anilox roller should have a screen line count in the range of 175-300 lines per inch (69-118 lines per cm).

The inking/coating apparatus 10 can also apply UV-curable inks and coatings. If UV-curable inks and coatings are utilized, ultra-violet dryers/extractors are installed adjacent the high velocity hot air dryer/extractor units 112, 114, respectively.

It will be appreciated that the inking/coating apparatus 10 described herein makes it possible to selectively operate a printing unit in either the flexographic printing mode or the lithographic printing mode, while also providing the capability to print or coat from either the plate or blanket position. The dual cradle support arrangement of the present invention makes it possible to quickly change over from inking/coating at the blanket

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cylinder position to inking/coating at the plate cylinder position with minimum press down-time, since it is only necessary to remove and reposition or replace the applicator roller 66 while the printing/inking apparatus is in the retracted position.

Moreover, the press operator may elect to spot or overall coat with aqueous ink/coating from the plate during one job, and then spot and/or overall coat from the blanket during the next job. Since the doctor blade assembly can be flushed and washed-up quickly and the applicator roller can be replaced quickly, it is possible to spot coat or overall coat from the plate position or the blanket position with aqueous inks or coatings during the first press run and then spot coat or overall coat with UV-curable inks or coatings from the plate position or from the blanket position during the next press run. The inking/coating apparatus 10 is completely out of the way in the retracted position; consequently, the doctor blade reservoir and supply lines can be flushed and washed-up by automatic wash-up equipment while the printing unit is printing another job.

The positioning of the applicator head and roller assembly relative to the plate and blanket is repeatable to a predetermined, preset impression position. Consequently, no printing unit adjustment or alteration is required, except for flushing the doctor blade assembly and cleaning or replacing the applicator roller to accommodate a different kind of ink or coating material. Although manual extension and retraction have been described in connection with the exemplary embodiment, extension to the operative position and retraction to a non-operative idle position can be carried out automatically by hydraulic or electric motor servomechanisms.

The Ferris wheel support arrangement allows the inking/coating apparatus to operate effectively in the interstation space between any adjacent printing units, as well as on the first or last printing units of the press, without blocking or obstructing the interstation space or restricting operator access to the cylinders of any of the printing units.

Finally, because the inking/coating apparatus of the present invention is mounted on a printing unit tower and is extendable to the operative position without requiring adjustment or alteration of the printing unit cylinders, it can be used for applying printing ink or coating material to the blanket cylinder of a rotary offset web press, or to the blanket of a dedicated coating unit.

Claims

1. Inking/coating apparatus (10) for use in a printing press (12) of the type having a printing unit (22, 24, 26, 28) on which a plate cylinder (32), a blanket cylinder (34) and an impression cylinder (36) are mounted for rotation, wherein the inking/coating apparatus is characterized by:

   an applicator head (60) for applying ink or coating material to a plate (P) mounted on the plate cylinder or to a blanket (B) mounted on the blanket cylinder, either separately or simultaneously when the inking/coating apparatus is in an operative position relative to the plate and blanket cylinders, and,

   a carriage assembly (58) for moving the applicator head to the operative position in which the applicator head is disposed laterally adjacent to the plate and blanket cylinders and for moving the applicator head from the operative position to a retracted position in which the applicator head is elevated with respect to the plate and blanket cylinders.

2. Inking/coating apparatus (10) as set forth in claim 1, wherein the carriage assembly (58) is characterized by:

   a support arm (88, 90) having a first end portion (88A) constructed for pivotal attachment to the printing unit and having a second end portion (88B) pivotally coupled to the applicator head (60), the applicator head being movable on the support arm to the operative position.

3. Inking/coating apparatus (10) as set forth in claim 1, characterized in that a counterweight (100, 102) is coupled to the carriage assembly.

4. Inking/coating apparatus (10) as set forth in claim 1, wherein the applicator head (60) is characterized by:

   a doctor blade assembly (68) having a reservoir (70) for receiving ink or liquid coating material; and,
   an applicator roller (66) coupled to the doctor blade assembly in fluid communication with the reservoir, the applicator roller being engagable with a printing plate (P) on the plate cylinder or with a blanket (B) on the blanket cylinder when the applicator head (60) is in the operative position.

5. Inking/coating apparatus (10) as set forth in claim 4, characterized in that the applicator roller (66) is an anilox roller having a resilient transfer surface.

6. Inking/coating apparatus (10) as set forth in claim 1, characterized in that:

   a power actuator (104, 106) is movably coupled to the applicator head (60), the power actuator having a power transfer arm (104A, 106A) which is extendable and retractable; and,
   movement converting apparatus (108) is coupled to the power transfer arm for converting

extension or retraction movement of the power transfer arm into pivotal movement of the applicator head (60) relative to the carriage assembly.

7. Inking/coating apparatus (10) as set forth in claim 6, wherein the movement converting apparatus (108) is characterized by:

a bell crank plate (111) having a first end portion coupled to the power transfer arm and having a second end portion for engaging a stop member;
a stop member (119) secured to the applicator head (60); and,
a clevis plate (115) secured to the carriage assembly (58) and pivotally coupled to the bell crank plate.

8. Inking/coating apparatus (10) as set forth in claim 1, wherein the applicator head (60) is characterized by:

first and second side frame members (74, 76) pivotally coupled to the carriage assembly (58);
a doctor blade assembly mounted on the first and second side frame members, the doctor blade assembly including a reservoir (70) for receiving ink or liquid coating material;
a cradle assembly (78, 80), (82, 84) mounted on the first and second side frame members, respectively;
an applicator roller (66) mounted for rotation on the cradle assembly and coupled to the doctor blade assembly for rolling contact with ink or coating material in the reservoir, the applicator roller being engagable with a printing plate (P) on the plate cylinder (32) or with a blanket (B) on the blanket cylinder (34) when the applicator head (60) is in the operative position; and,
a drive motor (62) coupled to the applicator roller for rotating the applicator roller.

9. Inking/coating apparatus (10) as set forth in claim 8, characterized in that:

the cradle assembly (79, 80) has first and second sockets (79, 81) disposed on the first and second side frame members respectively; and,
the applicator roller (66) is mounted for rotation on the first and second sockets.

10. Inking/coating apparatus (10) as set forth in claim 8, characterized in that

the cradle assembly (78, 80), (82, 84) includes first and second sockets (79, 81) disposed on the first and second side frame members, respectively, and third and fourth sockets disposed on the first and second side frame members, respectively; and,
the applicator roller (66) is selectively mountable for rotation on either the first and second sockets or on the third and fourth sockets for applying ink or coating material to either the plate or blanket when the applicator head is in the operative position.

11. Inking/coating apparatus (10) as set forth in claim 1, wherein the applicator head (60) is characterized by:

a first cradle (78, 80) for supporting an applicator roller (66) for engagement with the plate when the inking/coating apparatus is in the operative position; and
a second cradle (82, 84) for supporting an applicator roller (66) for engagement with the blanket (B) when the inking/coating apparatus is in the operative position.

12. Inking/coating apparatus (10) as set forth in claim 1, wherein the carriage assembly is characterized by:

a support arm (88, 90) having a first end portion pivotally coupled to the printing unit (88A, 90A) and having a second end portion (88B, 90B);
a common pivot shaft (77) on which the support arm second end portion and the inking/coating apparatus are pivotally mounted; and,
male and female latch members (103, 105) coupled between the common pivot shaft and the printing unit, with one of the latch members being secured to the common pivot shaft and the other latch member being constructed for attachment onto the printing unit, the latch members being mateable in interlocking engagement when the applicator head (60) is in the operative position.

13. Inking/coating apparatus (10) as set forth in claim 1, wherein the applicator head (60) and the printing unit are characterized by:

male and female latch coupling members (103, 105) mounted on the carriage assembly (58) and on the printing unit for releasably latching the carriage assembly in interlocking engagement with the printing unit when the applicator head is in the operative position.

14. Inking/coating apparatus (10) as set forth in claim 1, wherein the carriage assembly (58) is characterized by an elongated shank portion (88B, 90B) and a hub portion (88A, 90A), the elongated shank portion being pivotally coupled to the applicator head

(60) and the hub portion being constructed for pivotal attachment onto the printing unit.

15. A rotary offset printing press (12) having first and second printing units (22, 24) and the inking/coating apparatus (10) of claim 1 is movably coupled to the first printing unit (22) as set forth in claim 1, characterized by:

    a dryer (112) mounted on the first printing unit adjacent the impression cylinder (36) of the first printing unit for discharging heated air onto a freshly printed substrate while the freshly printed substrate is in contact with said impression cylinder.

16. A rotary offset printing press (12) as defined in claim 15, characterized in that:

    an extractor (112E) is disposed adjacent the dryer for extracting hot air, moisture and volatiles from an exposure zone (Z) between the dryer and the freshly printed substrate.

17. A rotary offset printing press (12) as defined in claim 15, characterized in that:

    an intermediate transfer cylinder (40) is coupled in sheet transfer relation with the impression cylinder (36) of the first printing unit (22); and,
    an interstation dryer (114) is disposed adjacent the intermediate transfer cylinder for discharging heated air onto a freshly printed or coated substrate after it has been transferred from the impression cylinder of the first printing unit and while it is in contact with the intermediate transfer cylinder (40).

18. A method for rotary offset printing in a printing press (12) of the type including first and second rotary offset printing units (22, 24), and using aqueous or UV-curable printing ink or coating material in the operation of at least the first printing unit, characterized by the following steps performed at each printing unit in succession:

    spot or overall coating a plate (P) with aqueous ink/aqueous coating material or UV-curable ink/UV-curable coating material;
    spot and/or overall coating a blanket (B) with aqueous ink/aqueous coating material or UV-curable ink or UV-curable coating material;
    transferring the printing ink or coating material from the printing plate (P) to the blanket (B);
    transferring the inked or coated image from the blanket to a substrate (S) as the substrate is transferred through the nip between the impression cylinder (36) and the blanket (B); and,
    drying the ink or coating material on the freshly printed substrate before the substrate is subsequently processed.

19. A method for rotary offset printing as defined in claim 18, wherein the drying step is characterized by:

    discharging high velocity, heated air onto the freshly printed/coated substrate (S) while the freshly printed/coated substrate is in contact with the impression cylinder (36) of the first printing unit (22).

20. A method for rotary offset printing as defined in claim 18, characterized by the steps:

    transferring the freshly printed substrate (S) from the first printing unit (22) to an intermediate transfer cylinder (40); and,
    drying the freshly printed substrate while it is in contact with the intermediate transfer cylinder.

21. A method for rotary offset printing as defined in claim 18, characterized by the step:

    extracting hot air, moisture and volatiles from an exposure zone (Z) above the freshly printed/coated substrate (S) while the freshly printed/coated substrate is in contact with the impression cylinder (36).

22. A method for rotary offset printing as defined in claim 18, characterized by the steps:

    applying a primer coating of an aqueous coating material or UV-curable coating material to a substrate (S) in the first printing unit (22); and,
    drying the primer coating on the substrate before the substrate is processed in the second printing unit.

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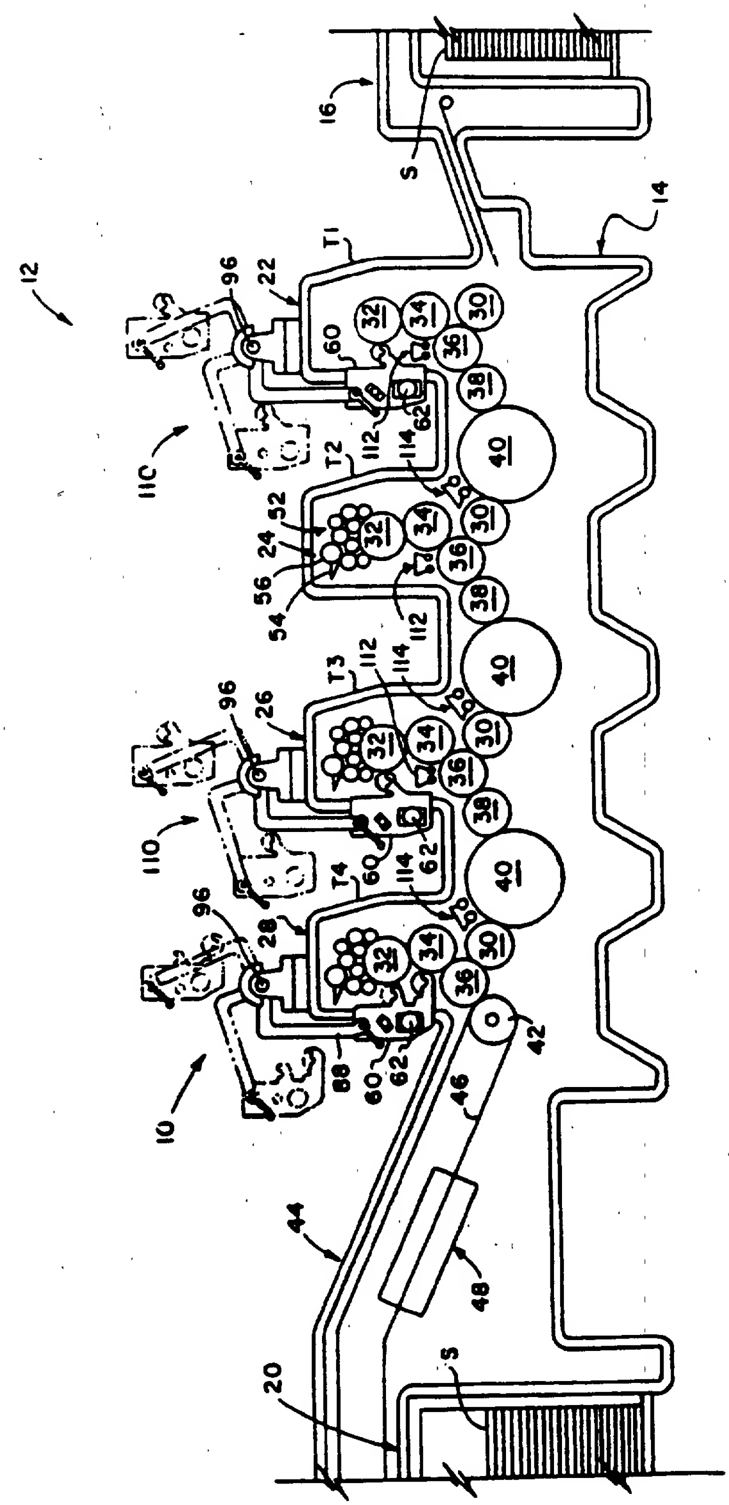
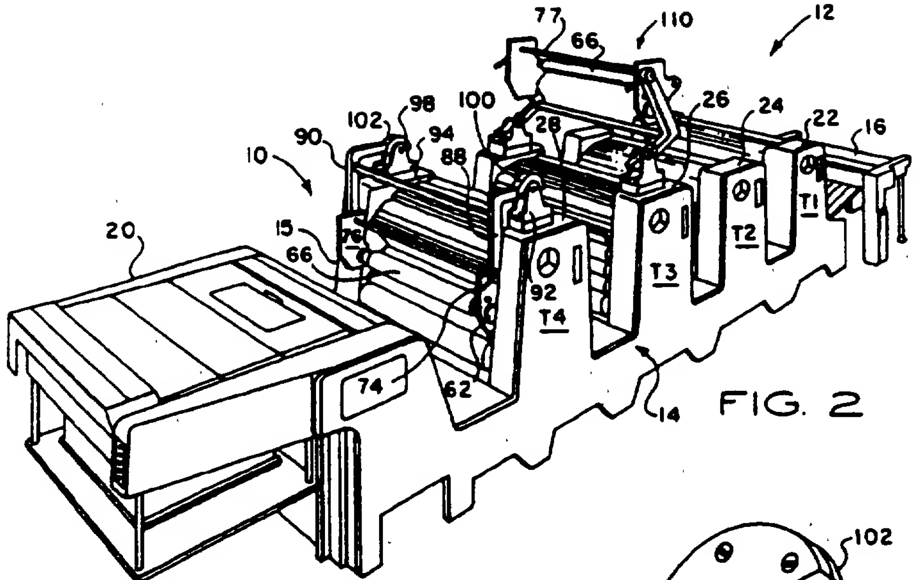


FIG. 1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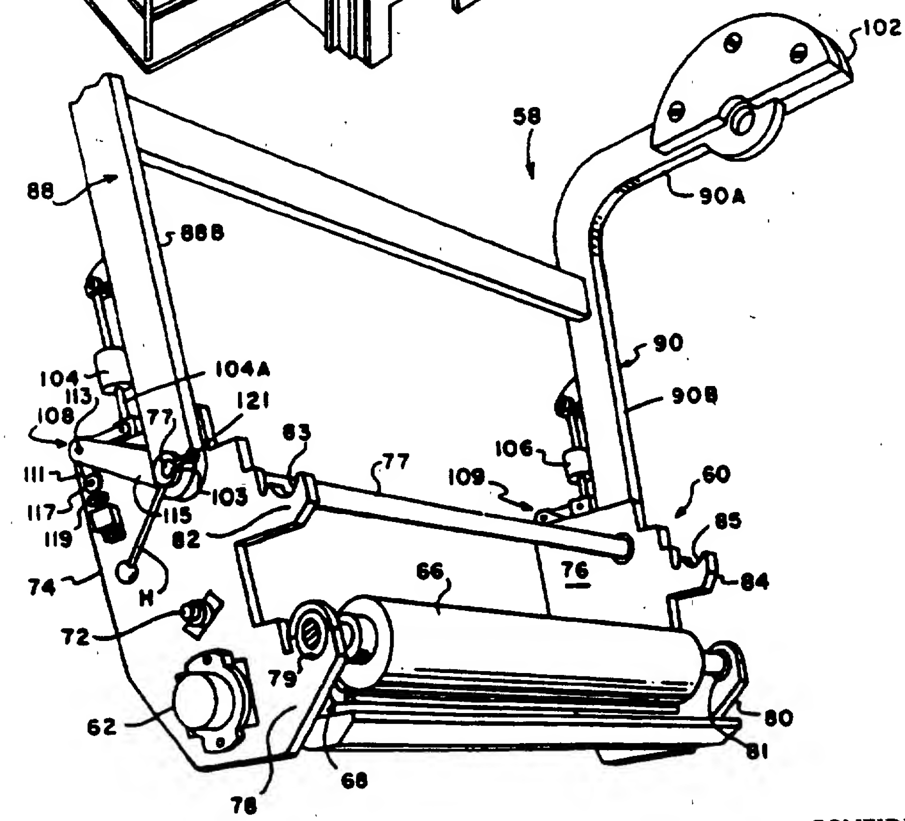
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FIG. 3

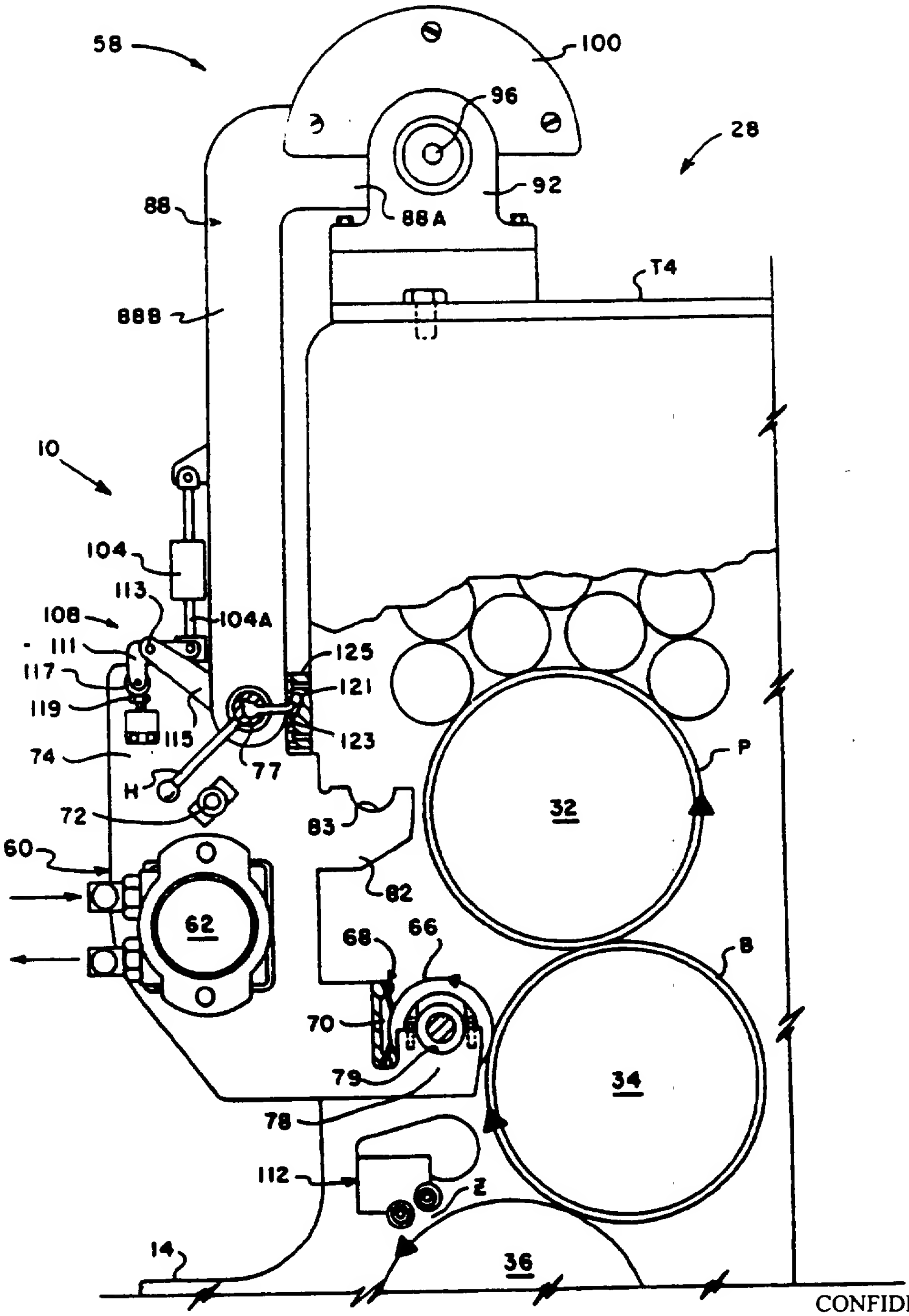
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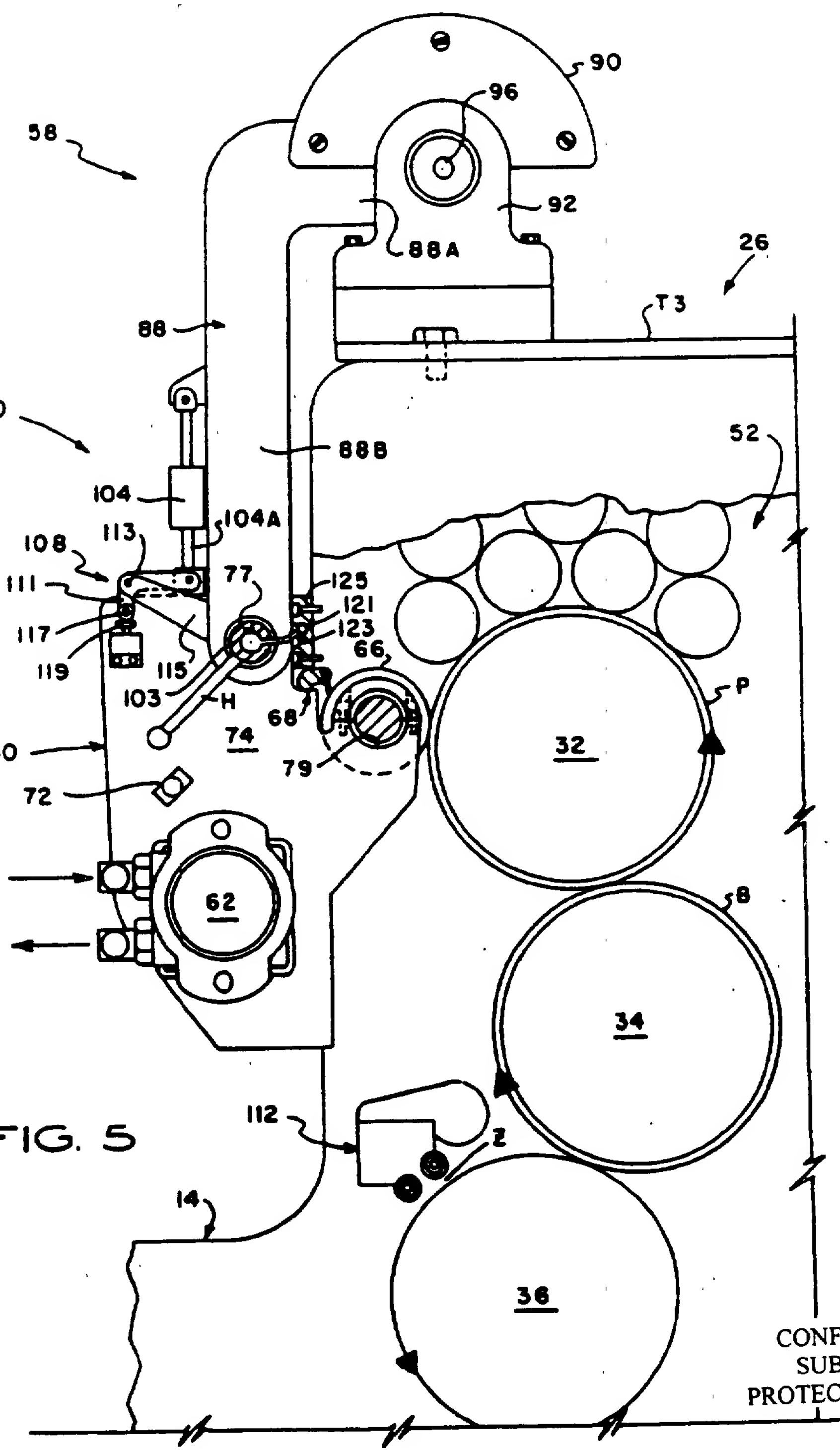
FIG. 4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112
Z
14
36

FIG. 5